Research Note 84-38

ESTIMATING MANPOWER, PERSONNEL, AND TRAINING REQUIREMENTS EARLY IN THE WEAPON SYSTEM ACQUISITION PROCESS: AN APPLICATION OF THE HARDMAN METHODOLOGY TO THE ARMY'S DIVISION SUPPORT WEAPON SYSTEM (APPENDICES)

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A Navy methodology designed to assess the human resource requirements of emerging weapon systems was applied to the Army's proposed Division Support Weapon System (DSWS), a self-propelled howitzer system which will eventually replace the present M109 howitzer series. The goal of the project was to determine whether or not this HARDMAN (hardware vs. manpower) Methodology could be used to examine the manpower, training, and personnel demands of proposed Army weapon systems. While the project examined only one system, the

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results of the project indicated that Army data was reasonably good in this case and the general analytic approach appeared to be useable. A second, more extensive project has been initiated to further assess the utility and generalizability of the methodology.

PREFACE

This report describes the application of the first four steps of the prototype HARDMAN methodology to an Army weapon system. The methodology was used to conduct an analysis of the manpower, personnel, and training requirements and costs generated by the operation and maintenance of the Self-Propelled Howitzer (SPH) of the proposed Enhanced Self-Propelled Artillery Weapon System (ESPAWS).

The prototype HARDMAN methodology is an integrated set of data base management techniques and analytic tools, designed to provide timely and fully documented assessments of the human resource requirements and costs associated with an emerging system's design. Additionally, the methodology provides the capability to determine the impact of a system's manpower, personnel, and training resource demand on the Army's current and/or projected supply of those assets, thereby targeting problem areas in system supportability. Effective tradeoff analyses can then be conducted through iteration of the methodology.

Volume I of this report details the application of the first four steps of the HARDMAN methodology to the ESPAWS SPH and the study's findings. Volume II provides supporting or supplemental data in a number of appendices.

The study effort was authorized under Task Order A-1 of Contract Number N61339-80-D-0005. The contract monitors were Drs. Donald O. Weitzman and Daniel T. Risser. Work related to the study was conducted by members of the Advanced Systems Department, Dynamics Research Corporation, Wilmington, Massachusetts. The Contract Program Manager was Peter Weddle. The Report Manager was Thomas E. Mannle, Jr. Principal contributors on the DRC Staff were Laurel Brown, David Herlihy, Edward Marquardt, Lawrence O'Brien, and Cecil Wakelin. Other contributors were Marjorie Bristol, John Glasier, David Hickernell, Richard Mills, John Snow and Annemarie Walsh. The principal programming was accomplished by Alan Pincus and Robert Kistler; David Hickernell provided supplementary programming. Administrative support was provided by Mary Shaffer, Nancy Tannalfo, Dianna DiGregorio, Debra Allfrey, Anne Bauman, Debra Mahoney, and Beth Kosis.

The success of the project was due in large part to the cooperation of a number of government organizations which provided support and assistance to ARI but bear no

responsibility for the results of the study. ARI is particularly grateful for the assistance provided by the U.S. Army Armaments Research and Development Command, Dover, New Jersey, (Program Manager - Cannon Artillery Weapon Systems); the U.S. Navy HARDMAN Program Office, Naval Annex, Washington, D.C.; the U.S. Army Field Artillery Center and School, Fort Sill, Oklahoma (TRADOC System Manager -- Cannon); Headquarters, Fort Sill, Oklahoma (Comptroller); the ARI Field Unit, Fort Sill, Oklahoma; Headquarters, Training and Doctrine Command (TRADOC) Fort Monroe, Virginia (Deputy Chief of Staff -- Resource Management, and Deputy Chief of Staff -- Training); and the U.S. Army Armaments Material Readiness Command, Rock Island, Illinois (Logistics Assessment).

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INTRODUCTION

The information presented in Appendices A through C was developed during the application of the HARDMAN Methodology to the Enhanced Self-Propelled Artillery Weapon System (ESPAWS) prior to and during the conceptual stage of its development. A Consolidated Data Base (CDB) was developed to support the analysis of a suitable conceptual system to represent an ESPAWS design.

Appendix A contains descriptions of the data and data sources supporting the study. Appendix B describes the analytic tools which were used in each step of the methodology. Appendix C contains training analysis information which was included as a separate entity due to the volume of data and analysis products.

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APPENDIX A1
DATA SOURCES INDEX

FUNCTIONAL AREA: MISSION

CATEGORY	DATA	SOURCE	COMMENTS
1. Need	System Operational Need	Chief of Staff of the Army (CSA); Mission Element Need Statement (MENS)	MENS for ESPAWS issued Dec, 1980
2. Capabilities	Operational Capability within Specified Areas	TRADOC: Fire Support Mission Area Analysis (MAA) Phase 1;	
	Mission Requirements	TRADOC: Battlefield Development Plan (BDP) GSA: MENS	
3. Environment	Scenario	TRADOC: Field Artillery Center and School, Ft Sill,OK	
	Operating Concepts (Logistics, Maintenance)	TRADOC: Field Artillery Center and School, Ft Sill,OK	
	Detailed Usage Data; i.e., scenario in terms of usage metrics	TRADOC: Field Artillery Center and School, Ft Sill,OK Mission Profile/ Operational Mode Summary (MP/OMS)	Representative for ESPAWS

FUNCTIONAL AREA: MANPOWER

CATEGORY	DATA	SOURCE	COMMENTS
1. Workload	Maintenance	Navy: Maintenance Data Collection System. (MDCS)	Autoloader, computer, AHRS

FUNCTIONAL AREA: MANPOWER (CONTINUED)

CATEGORY	DATA	SOURCE	COMMENTS
	Maintenance	Army: AR:750-37 Sample Data Collection	
	Operational Manning	ARI: Howitzer Crew Size Model	Primary Fire Tasks
	Operational Manning	Field Artillery School: Mission Profile for SPH	
2. Methodology	Constraints	AR570-2 Manpower Authorization Criteria (MACRIT)	
	Allowances	AR570-2 Manpower Authorization Criteria (MACRIT)	
	Capabilities	Field Artillery School: Mission Profile for SPH	
	Projected Mission Environment	Field Artillery School: Mission Profile for SPH	

FUNCTIONAL AREA: TRAINING

CATEGORY	DATA	SOURCE	COMMENTS
1. Task Requirements	Task by MOSC	Soldier's Manuals Commander's Manuals	
	Tasks by System	Field Manuals Technical Manuals	
	Tasks Accomplished by MOSC	Consolidated Occupational Data Analysis Program (CODAP)	

FUNCTIONAL AREA: TRAINING (CONTINUED)

CATEGORY	DATA	SOURCE	COMMENTS
	Maintenance Tasks Information	Field Manuals Technical Manuals	
2. Skill/Skill Levels	Task Requirements Required by Skill Level	Soldier's Manuals Commander's Manuals	
	MOS Skill Descriptions	AR611-201 Enlisted Career Management Fields and Occupational Specialties	
	Qualification Standards	Skill Qualification Tests (SQT)	
3. Course Information	Training Paths	Comptroller of the Army (COA): Military Occupational Specialty Cost Handbook	
	Synopsis of Formal School Courses	U.S. Army Formal Schools Catalog, DA PAM 351-4	
	Synopsis of Correspondence Courses	Army Correspondence Course Program	
	Synopsis of Planned Army Training Courses	Individual and and Collective Outline Training Plan (ICTP)	
	Instructor Determination Data	TRADOC Form 377-R for relevant courses	
4. Training Devices/ Extension Training Materials	List and Description of Current Items in Inventory	Index And Description of Army Training Devices (DA PAM 310-12) Catalog of TASO Training Devices (TRADOC PAM 71-9) Extension Material Status List (Quarterly Publication)	

FUNCTIONAL AREA: PERSONNEL

CATEGORY	DATA	SOURCE	COMMENTS
1. Current Enlisted Personnel Information	Army Personnel Status	MILPERCEN Enlisted Master File (EMF)	
2. Personnel Management	Military Occupational Specialty Information	AR611-201: Enlisted Career Management Fields and Military Occupational Specialties	

FUNCTIONAL AREA: COST

CATEGORY	DATA	SOURCE	COMMENTS
1. Hardware	Development Costs	ARRADCOM LCC Guidance ESPAWS Contractors	
	Operating and Support Costs	ARRADCOM LCC Guidance ESPAWS Contractors	
2. Personnel	Salaries	Comptroller of the Army (COA): Force Cost Information System: Army Force Planning Cost Handbook (AFPCH)	
	Other Per Capita Costs	Comptroller of the Army (COA): Force Cost Information System: Army Force Planning Cost Handbook (AFPCH) Per Capita Factor	
3. Training	Course Cost Elements: Aggregate	COA: Soldier Cost Information System: MOS Training Cost Handbook (MOSB)	

FUNCTION AREA: COST (CONTINUED)

CATEGORY	DATA	SOURCE	COMMENTS
	Detailed	TRADOC: Cost Analysis of Training Centers and Schools (one each)	
	Cost Factors and Estimating Relationships	TRADOC: Resource Factors Handbook	

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APPENDIX A2
THE SAMPLE DATA COLLECTION SYSTEM

A2.1 BACKGROUND

The Army has no periodic field maintenance data reporting system. Interviews with Army sources revealed that this was not always true. From 1962 until 1969, there was such a reporting system in effect, known as TAERS -- The Army Equipment Reporting System. Data collected under the TAERS system were not viewed as being either accurate or reliable for a number of reasons. Prominent among these were that:

- Data were collected by unit personnel in addition to their normal duties;

- Little feedback was received by unit personnel on the purposes for which the data were used. Consequently there was little incentive to record data accurately; and,

- Recognition of these circumstances at the National Maintenance Points (to which data flowed), caused data to be viewed as suspect and thus not exploited, further compounding the problem at the unit level.

In 1969, the TAERS system was eliminated, due to the circular nature of the problem and as a result of resource pressures caused by the Vietnam conflict. In the early 1970's, the Army initiated the Sample Data Collection (SDC)

system in an effort to receive accurate field maintenance data without reporting the TAERS experience.

A2.2 THE SAMPLE DATA COLLECTION SYSTEM

The Sample Data Collection System is prescribed by Army Regulation (AR) 750-37, the most recent version of which is dated June 15, 1977. AR 750-37 prescribes three types of data collection:

- Free Flow: Unedited data recorded by unit personnel, on existing maintenance (TAMMS) forms, and submitted to the National Maintenance Point level.

- Semi-Controlled: Data are recorded by unit personnel on standard or reasonably modified TAMMS forms. On-site representatives collect, edit, and format the data.

- Controlled/Intense: Data are recorded by dedicated data collectors, possibly on special forms.

AR 750-37 also provides that before an SDC effort is approved, an SDC plan must be developed. An SDC plan contains a description of the equipment on which data collection is desired (description, range); the nature, purpose, use, and users of the data; duration, cost of the effort, and the expected availability of resources; sampling technique, sample size, statistical, and engineering analysis methods; and, the essential elements of information, data portrayal, and output product

requirements. A draft Department of the Army (DA) Circular is also included, since each SDC effort is promulgated by circular.

Before SDC plans are approved, AR 750-37 requires each plan to be coordinated so as to ensure proper interface with all existing developmental management information systems that use or plan to use SDC data as inputs. Data requirements of users, other than those who originated the requirement for the data, can then be integrated into the SDC plan.

As of March, 1981, there have been 77 SDC efforts. Some of these have been multiple or extended efforts on the same item or items of equipment. Table A2-1 displays the list of SDC efforts.

A2.3 THE FIELD ARTILLERY SAMPLE DATA COLLECTION (FA SDC)

The Field Artillery Sample Data Collection was initiated in 1977. For the M109A1 subset of the FA SDC, data collection efforts were begun in January, 1977, at Fort Sill, Oklahoma, and in May, 1977, at Fort Hood, Texas and Grafenwoeher, Germany. One battalion (18 SPH) at Fort Sill, two battalions (42 SPH) at Fort Hood, and battalions selected during their annual training cycle in Germany were part of the sample. Over the 2.5 year period (for the tape which DRC used) the sample size was 72 SPH.

Data were collected by contractor personnel using Form 260 from the Armaments Readiness Command (ARRCOM) at Rock Island, Illinois. ARRCOM is the proponent and custodian of the FA Sample Data Collection. These data were formatted by ARRCOM onto computer tape into 44 fields of information.

Table A2-1 SAMPLE DATA COLLECTION EFFORTS

DA Circular No.	Equipment Nomenclature	Type Collection
750-37-1	Gun, Air Defense 20mm M114A1E1	Note: Semi-Controlled
750-37-2	Generator, 60kw 60Hz SF-60-MD	Unless otherwise noted
750-37-3	Truck, ¼ ton, M151A1/A2	
750-37-4	Armored Reconnaissance Airborne Assault Vehicle, M551	
750-37-5	Truck 5 Ton M809	
750-37-6	Truck 1-¼ ton, M561	
750-37-7	Terminal, Digital Subscriber AN/FYA-71	
750-37-8	Radio Set, AN/GRC-106A	
750-37-9	Radar Set, AN/PPS-5A	
750-37-10	Radio Set, AN/GRC-143	
750-37-11	Truck, Commercial Tractor 5 ton 1HC Model 2000D	
750-37-12	LANCE	
750-37-13	Generator, 15kw 60Hz SF-15-MD	
750-37-14	Gun, Air Defense, M163A1 VULCAN	
750-37-15	M 551 (Extend)	
750-37-16	M 151 (Extend)	
750-37-17	AN/FYA-71 (Extend)	
750-37-18	M561 (Extend)	
750-37-19	VULCAN (Extend)	
750-37-20	Trucks, 5 ton and 2-½ ton, Useful Life	
750-37-21	LANCE (Extend)	
750-37-22	HAWK	
750-37-23	Truck, Commercial Tractor, 2000D (Extend)	
750-37-24	Teletype, TT-636U	
750-37-25	M561 (Extend—3rd year)	
750-37-26	M151 (Extend—3rd year)	
750-37-27	HAWK (Extend)	
750-37-28	LANCE (Extend—3rd year)	
750-37-29	Trucks, 5 and 2-½ ton, Useful Life (Extend)	
750-37-30	GOER Vehicle	
750-37-31	Countermeasures Set, AN/GLQ-3	
750-37-32	GOER Vehicle	
750-37-33	Trucks, 5 and 2-½ ton, Useful Life (Extend)	
750-37-34	Generator, 60kw (2nd time)	
750-37-35	Truck, M880	
750-37-36	Truck, 5 ton (Extend)	
750-37-37	Field Artillery Weapons Systems	
750-37-38	Tugs	
750-37-39	COMSEC Equipment, TSEC/KG-27	
750-37-40	Truck, 5 ton (Extend)	
750-37-41	Helicopter, Attack, AH-15 COBRA	
750-37-42	M880 (Extend)	
750-37-43	Field Artillery Weapon Systems (Extend—2nd year)	
750-37-44	M880 (Extend)	

Table A2-1 (continued)

DA Circular No.	Equipment Nomenclature	Type Collection
750-37-45	Administrative Use Vehicles (AUV) in Germany	
750-37-46	Transport, Heavy Equipment, M911	
750-37-47	FA Weapon Systems (Extend, 3rd year)	Controlled
750-37-48	Radar, Forward Area Acquisition (FAAR)/Chapparral	
750-37-49	Aircraft Systems	
750-37-50	Fire Control, AN/TSQ-73	
750-37-51	VULCAN	Controlled
750-37-52	COMSEC equipment, TSEC/KY-57/58 VINSON	Controlled
750-37-53	M880 (Extend)	
750-37-54	Tank, M60A3	Controlled
750-37-55	Trucks, Medium and Heavy, M915 series	
750-37-56	Helicopter, Utility, UH-60 Blackhawk	Controlled
750-37-57	Helicopter, Utility, UH-60 Blackhawk	Semi-Controlled
750-37-58	M911 (Extend)	
750-37-59	AUV	
750-37-60	AN/TSQ-73 (Extend)	
750-37-61	FAAR/Chaparral (Extend)	
750-37-62	Aircraft Systems	
750-80-1	FA Weapon Systems (Extend—4th year)	Controlled
750-80-2	Radio Receiver Set, AN/URR-74	
750-80-3	Generators, 5kw, 15kw, 30kw	
750-80-4	VINSON (Extend)	
750-80-5	M880 (Extend)	
750-80-6	Improved HAWK	
750-80-7	M60A3 (Extend)	
750-80-8	M915 (Extend)	
750-80-9	UH-60 (Extend)	Controlled
750-80-10	M911 (Extend)	
750-80-11	Tank and Pump Unit, Petroleum	
750-81-1	Landing Craft, Utility	
750-81-2	Ribbon Bridge	
750-81-3	Medical Unit Surgical, Transportable (MUST)	
750-81-4	UH-60 (Extend)	Semi-Controlled

Source: US Army Materiel Development and Readiness Command (DARCOM)

DRC extracted 23 fields of interest for the ESPAWS study effort. Table A2-2 portrays one maintenance incident as it appears on the extracted tape, and Table A2-3 provides a fuller explanation of the extracted fields.

A2.4 DRC DATA MANIPULATION TECHNIQUES

From discussions with ARRCOM personnel, and by inspecting an abstract of the data contained in the M109A1 SDC, DRC recognized that the SDC afforded the opportunity to compute at least the RAM parameters of interest, if not also maintenance workload. However, before these analysis processes could begin, the raw data had to be processed into a form suitable for analysis. The techniques developed by DRC to process the data will be described here. Appendices B1 through B3 describe the analysis routines and programs developed by DRC to convert the processed data into meaningful inputs for the *HARDMAN methodology*.

Figure A2-1 portrays the flow of data through the required manipulation routines. The data were first converted to the format required by DRC's Honeywell mainframe computer. An extract routine (/CONVER.C) provided a tape of each maintenance incident described by the 23 information fields of interest to the ESPAWS study, rather than the 44 fields on the original tape. A sort routine separated the useable records from those that could not be used. Of the original records on tape, only 3209 were found to contain manhours information, which was needed to compute maintenance workload. The other records on the original tape indicated one of three circumstances: (1) a vehicle entering the SDC sample, indicated by "BASE", instead of the normal incident number; (2) a vehicle leaving the SDC sample indicated by a

Table A2-2 FA SAMPLE DATA COLLECTION (EXTRACT)

T2488 2108 M109A1 932 2219 932 23199 184.00 0710 B TRANSMISSION
2520-735-4210 835 1099 BA 3.0 3.0 8.0 0.0 6.0 3.0 16.0 0.0
63C 5 3 13B 5 3 13B 4 3 63H 5 8 63H 4 8 DS 8055 M Q N

INCIDENT NO.	:	T2488	EFFECT	:	B
VEHICLE SERIAL NO.	:	2108	ACTION	:	A
SYSTEM	:	M109A1	AMT	:	3.0 3.0 8.0 0.0
ROUNDS ON SYSTEM (CUM)	:	932	MMH	:	6.0 3.0 16.0 0.0
MILES ON SYSTEM (CUM)	:	2219	SPEC, GR, MH	:	63C 5 3
ROUNDS ON TUBE (CUM)	:	932			13B 5 3
TUBE SERIAL NO.	:	23199			13B 4 3
PART COST	:	184.00			63H 5 8
GG NO.	:	0710			63H 4 8
SUBSYSTEM	:	B	PART FROM	:	DS
PART NAME	:	TRANSMISSION	JULIAN DATE	:	8055
NSN	:	2520-735-4210	DEPENDENCY	:	M
PART NUMBER	:	8351099	FAILURE CODE	:	Q
			H/N	:	N

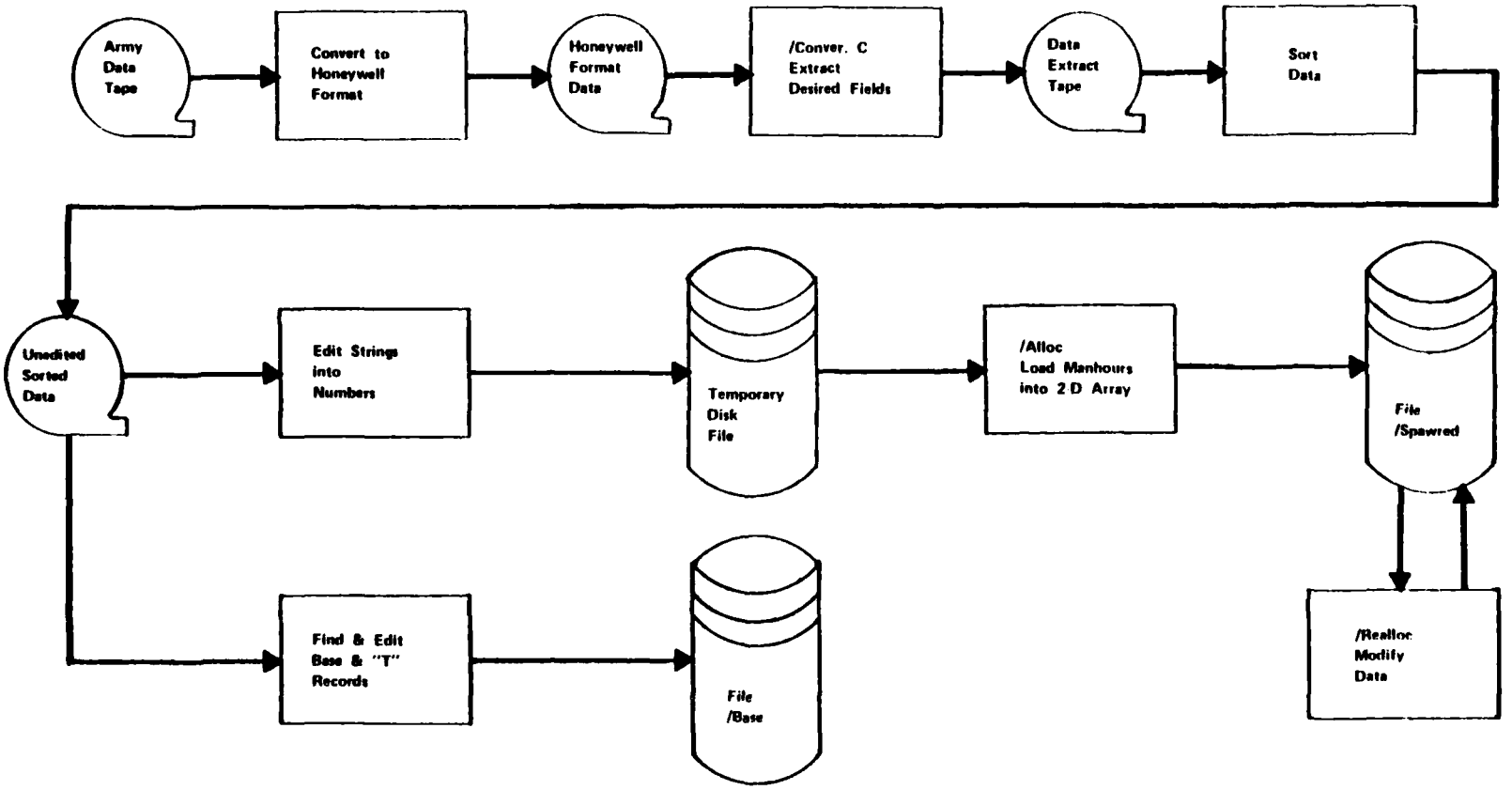
Table A2-3 DESCRIPTION OF SDC FIELDS

Field		Description
Incident No.	:	First character is letter (or blank) indicating where the incident took place. Next four characters form a chronological incident number unique to that site. Sixth character has two possibilities: "S," if an incident is pursuant to another incident, and "T" if the particular system is leaving the SDC sample. "BASE" instead of the standard incident number format indicates an entry into the SDC sample.
Vehicle Serial No.	:	Self-explanatory. A letter in the last position indicates vehicles that have transferred out of SDC and then reappear later.
System	:	M109A1, all cases
Rounds on System (CUM)	:	Cumulative rounds fired by the system since last rebuild
Miles on System (CUM)	:	Cumulative miles driven by the system since last rebuild
Rounds on Tube (CUM)	:	Cumulative rounds on tube since manufacture
Tube Serial No.	:	Self-explanatory
Part Cost	:	Standard price of part(s) replaced or used
GG No.	:	Government Functional Grouping Code of the subsystem which was the root cause of the incident
Subsystem	:	Same purpose as GG No. except alphabetic and less extensive functional breakdown.
Part Name	:	Part name (of general type of maintenance) which was repaired or replaced (or performed) on the vehicle.
NSN	:	National Stock Number of the replaced part(s)
Part No.	:	Manufacturer's part number, listed in Technical Manuals
Effect	:	Represents the effect of the malfunction on the vehicle's ability to perform. A: Critical/safety B: Mission Stop/Start C: Other
Action	:	Type of maintenance action required to correct the malfunction A: Replace/unscheduled B: Repair/unscheduled C: Preventive/scheduled D: Adjust E: Other
AMT	:	Active Maintenance Time: Clock or elapsed maintenance time between the start of a maintenance action and its completion. Four values, one each for the crew, organizational, direct support, and general support echelons of maintenance, respectively.
MMH	:	Maintenance Manhours. Same format as AMT.

Table A2-3 (continued)

Field		Description
SPEC, GR, MMH	:	A five variable array, each variable containing the specialty (MOS) and paygrade of an individual performing maintenance and the maintenance manhours he or she devoted to the task. Not arranged by echelon.
Part From	:	Echelon of supply that supplied the part
Julian Date	:	Date of the incident
Dependency	:	Usage criteria to record malfunction against a particular subsystem. M: Miles driven R: Rounds fired
Failure Code	:	Failure code (FCD) of the incident as judged by ARRCOM. The FCD alphabetic matrix combines two scoring criteria, the ARRCOM/TRADOC (SC), and the Joint Munitions Effectiveness Manual (JMEM).
H/N	:	Failure chargeable to either hardware or non-hardware causes.

Figure A2-1 DRC DATA MANIPULATION ROUTINES



"T" suffix (for transferred) to the incident number; and (3) an incident pursuant to another incident, indicated by an "S" suffix (for supplementary record) to the normal incident numbers. (While the "BASE and T" records could not be used in calculating maintenance manhours, they were used to establish start and end points for each vehicle in the SDC, and to compute the Mean Metric (Miles, Rounds) Between Failure. This computation routine used the /BASE and /SPAWRED Files; however, the computational step itself is not shown on the flowchart.) An additional 100 records were excluded because they indicated they encompased miscellaneous "NO TEST" conditions. Table A2-4 summarizes the derivation of records useable for computation of maintenance manhours from the original SDC data.

Another and more significant development in the data manipulation flow was the need to develop the REALLOC program. REALLOC allowed modification of the data (i.e., changing, adding, or deleting data element values). REALLOC was necessary because the SPEC, GR, and MMH field (see Table A2-2) was not arrayed by echelon. Although AMT and MMH were identified to a particular echelon, the design of ARRCOM Form 260, on which the data were collected, permitted only five entries for the SPEC, GR, and MMH field. Thus, data entry was haphazard, in some cases in descending or ascending numerical MOS order, in other cases by MMH quantity order. Standard sort and edit routines could match the MMH part of the SPEC, GR, and MMH field to the AMT and MMH fields for a provisional allocation of MOSs to echelons; in some cases, however, the results were clearly unsatisfactory, e.g., an MOS 13B (Cannon Crewmember) appearing at the general support echelon of maintenance, and a civilian wage grade worker appearing at the crew level.

Table A2-4 DERIVATION OF USABLE RECORDS

Description	Number
Total Records	6031
Less: Records with No Maintenance Manhours	2722
• "BASE": start SDC	(599)
• "T" Suffix: Complete SDC	(581)
• "S" Suffix: Supplementary Record	(1542)
Miscellaneous "No Test" Records	100
Total, Usable Records	3209
• Unscheduled Maintenance	(3623)
• Scheduled Maintenance	(586)

DRC developed /REALLOC as an interactive update program which allowed review of each maintenance incident. In cases where the provisional allocation of an MOS to a particular echelon appeared questionable, /REALLOC was used to reallocate the existing labor to echelons consistent with the TOE, insofar as possible. While /REALLOC was also developed with the capability to change, add, or delete data from the existing record, this capability was not exercised except to correct what appeared as obvious data entry errors.

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APPENDIX A3

EQUIPMENT LISTS

A3.1 Predecessor System Equipment List

A3.2 Reference System Equipment List

A3.3 Conceptual System Equipment List

A3.1 PREDECESSOR SYSTEM EQUIPMENT LIST

Group Number	Component/Assembly
0100	Engine, V8 diesel, model 8V71T, Detroit Diesel GMC; and Shock mounts
0101	Cylinder head
0102	Vibration damper
0103	Flywheel
0104	Pistons and connecting rods
0105	Valves and valve rockers
0106	Oil filter, oil cooker, and external lines/fittings
0108	Exhaust manifold
0109	Accessory drive mechanism
0301	Fuel injector
0302	Fuel pump and relief valve
0304	Air cleaner, filter pack, ducts, hoses, and dust exhaust motor
0305	Engine intake blower, blower drive shaft, turbo charger, air duct, and tubocharger regulator
0306	Fuel tank, fuel lines, and fittings
0308	Engine governor
0309	Primary and secondary fuel filter element and fuel filters
0311	Engine heater air box
0312	Injector rock control, control tube, accelerator and throttle control linkage, and rod end bearings
0401	Exhaust pipe
0501	Radiator
0502	Radiator shroud
0503	Water manifold, thermostat; hoses and pipes
0504	Water pump
0505	Fan drive assembly and fan drive housing; fan thermostat
0507	Unspecified cooling system parts
0601	Leece-Neville alternator, model A001-5504AA
0602	Voltage regulator and rectifier
0603	Starter and starter solenoid; field coil; starter drive
0607	Circuit breaker; instrument panel and wiring harness lamps; indicator light; accessory socket and switches

0608	Circuit breaker relay and switches; starter and master relays; motor relay
0609	Lamp and lamp units; lights and dome light
0610	Sending units and warning switches
0612	Batteries (12V-type 6TN) and battery cables
0613	Wiring harnesses (hull, cab and power plant)
0614	Electrical contact brushes and slip rings
0616	Ventillating blower
0617	Trailer electrical coupling
0618	Rammer control assembly; cab power relay box; gunner's selector switch box; rammer switches and wiring harness; intercom wiring harness
0710	Transmission (model XTG-411-2A, Allison Div., GMC) and transmission seals, coupling shaft, brake and control valve
0711	Shifting controls and linkage/rod end brearing
0714	Control valve
0719	Trainer
0721	Transmission oil pump and filter
0801	Power transfer and final drive assemblies
1103	Final drive
1201	Hand brakes
1206	Mechanical brakes
1301	Torsion bar
1302	Road wheel and arm; hub brearing; hub bearing seal
1303	Eccentric spindle control; spindle seal; track adjusting cylinder; idler arm and wheel; track idler support housing
1304	Drive sprocket and hubs
1305	Track and track shoes
1401	Steering controls
1503	Towing hooks; pintel
1604	Shock absorbers and road wheel arm bumper
1801	Cover plate and doors; travel lock
1802	Fender and track skirt
1803	Driver's hatch
1806	Seat
1808	Boxes, sockets and straps
1901	Tureet race
1903	Doors and ports
1904	Traversing mechanism and controls
1906	Internal and external stowage
1909	Rammer and spade hoist assembly

1910	Equilibrating elevating mechanism and controls
2005	Spade and spade lock
2205	Bilge pump
2207	Personnel heater; heater fuel filter, igniter and flame detector switch
2210	Vehicle data plate
2604	Cannon bore brush assembly
2801	Sighting and fire control equipment: Commander's periscope (M42) Panoramic telescope (M117) Panoramic telescope mount (M145) Direct fire telescope (M118C and M11CA1) Direct fire telescope mount (M146) Elevation quadrant (M15) Trunion bracket ring Infinity aiming reference collimator (M1) Carrying case (M82)
3303	Winterization
3307	Deep water fording
3401	Cannon (M126A1/M185) 155mm and mount (M127)
3402	Machine gun .50 calibre (M2)
3403	RFire control
4309	Hydraulic equilibration system; primary and secondary accumulators
4701	Speedometer and speedometer drive components; tachometer and tachometer drive components
7639	Fixed (10 lb. bottle) system and portable (5 lb.) bottles
9501	Hardware supplied in bulk materials

A3.2 REFERENCE SYSTEM EQUIPMENT LIST

Group Number	Component/Assembly
0100	Engine, V8 diesel, model 8V71T, Detroit Diesel GMC; and Shock mounts
0101	Cylinder head
0102	Vibration damper
0103	Flywheel
0104	Pistons and connecting rods
0105	Valves and valve rockers
0106	Oil filter, oil cooker, and external lines/fittings
0108	Exhaust manifold
0109	Accessory drive mechanism
0301	Fuel injector
0302	Fuel pump and relief valve
0304	Air cleaner, filter pack, ducts, hoses, and dust exhaust motor
0305	Engine intake blower, blower drive shaft, turbo charger, air duct, and tubocharger regulator
0306	Fuel tank, fuel lines, and fittings
0308	Engine governor
0309	Primary and secondary fuel filter element and fuel filters
0311	Engine heater air box
0312	Injector rock control, control tube, accelerator and throttle control linkage, and rod end bearings
0401	Exhaust pipe
0501	Radiator
0502	Radiator shroud
0503	Water manifold, thermostat; hoses and pipes
0504	Water pump
0505	Fan drive assembly and fan drive housing; fan thermostat
0507	Unspecified cooling system parts
0601	Leece-Neville alternator, model A001-5504AA
0602	Voltage regulator and rectifier
0603	Starter and starter solenoid; field coil; starter drive
0607	Circuit breaker; instrument panel and wiring harness lamps; indicator light; accessory socket and switches
0608	Circuit breaker relay and switches; starter and master relays; motor relay

0609	Lamp and lamp units; lights and dome light
0610	Sending units and warning switches
0612	Batteries (12V-type 6TN) and battery cables
0613	Wiring harnesses (hull, cab and power plant)
0614	Electrical contact brushes and slip rings
0616	Ventillating blower
0617	Trailer electrical coupling
0618	Rammer control assembly; cab power relay box; gunner's selector switch box; rammer switches and wiring harness; intercom wiring harness
0710	Transmission (model XTG-411-2A, Allison Div., GMC) and transmission seals, coupling shaft, brake and control valve
0711	Shifting controls and linkage/rod end brearing
0714	Control valve
0719	Trainer
0721	Transmission oil pump and filter
0801	Power transfer and final drive assemblies
1103	Final drive
1201	Hand brakes
1206	Mechanical brakes
1301	Torsion bar
1302	Road wheel and arm; hub brearing; hub bearing seal
1303	Eccentric spindle control; spindle seal; track adjusting cylinder; idler arm and wheel; track idler support housing
1304	Drive sprocket and hubs
1305	Track and track shoes
1401	Steering controls
1503	Towing hooks; pintel
1604	Shock absorbers and road wheel arm bumper
1801	Cover plate and doors; travel lock
1802	Fender and track skirt
1803	Driver's hatch
1806	Seat
1808	Boxes, sockets and straps
1901	Tureet race
1903	Doors and ports
1904	Traversing mechanism and controls
1906	Internal and external stowage
1909	Rammer and spade hoist assembly
1910	Equilibrating elevating mechanism and controls

1920	Attitude Heading and Reference System: AN/ASN-107
1925	FM Radio: AN/VRC-12
1930	Ammunition Autoloader: FMC design configured from MK 42 Mod 10 5"/54 gun mount
2005	Spade and spade lock
2205	Bilge pump
2207	Personnel heater; heater fuel filter, igniter and flame detector switch
2210	Vehicle data plate
2604	Cannon bore brush assembly
2801	Sighting and fire control equipment: Commander's periscope (M42) Panoramic telescope (M117) Panoramic telescope mount (M145) Direct fire telescope (M118C and M11CA1) Direct fire telescope mount (M146) Elevation quadrant (M15) Trunion bracket ring Infinity aiming reference collimator (M1) Carrying case (M82)
2810	Fire Control Computer: AN/ASQ-155
3303	Winterization
3307	Deep water fording
3401	Cannon (M126A1/M185) 155mm and mount (M127)
3402	Machine gun .50 calibre (M2)
3403	RFire control
4309	Hydraulic equilibration system; primary and secondary accumulators
4701	Speedometer and speedometer drive components; tachometer and tachometer drive components
7639	Fixed (10 lb. bottle) system and portable (5 lb.) bottles
9501	Hardware supplied in bulk materials

A3.3 CONCEPTUAL SYSTEM EQUIPMENT LIST

Group Number	Component/Assembly
*0100	Engine, V8 diesel, model 8V71T, Detroit Diesel GMC; and Shock mounts
*0101	Cylinder head
*0102	Vibration damper
*0103	Flywheel
*0104	Pistons and connecting rods
*0105	Valves and valve rockers
*0106	Oil filter, oil cooker, and external lines/fittings
*0108	Exhaust manifold
*0109	Accessory drive mechanism
*0301	Fuel injector
*0302	Fuel pump and relief valve
*0304	Air cleaner, filter pack, ducts, hoses, and dust exhaust motor
*0305	Engine intake blower, blower drive shaft, turbo charger, air duct, and tubocharger regulator
*0306	Fuel tank, fuel lines, and fittings
*0308	Engine governor
*0309	Primary and secondary fuel filter element and fuel filters
*0311	Engine heater air box
*0312	Injector rock control, control tube, accelerator and throttle control linkage, and rod end bearings
0401	Exhaust pipe
*0501	Radiator
*0502	Radiator shroud
*0503	Water manifold, thermostat; hoses and pipes
*0504	Water pump
*0505	Fan drive assembly and fan drive housing; fan thermostat
*0507	Unspecified cooling system parts
*0601	Leece-Neville alternator, model A001-5504AA
*0607	Voltage regulator and rectifier
*0603	Starter and starter solenoid; field coil; starter drive
*0607	Circuit breaker; instrument panel and wiring harness lamps; indicator light; accessory socket and switches

* Improved RAM

*0608	Circuit breaker relay and switches; starter and master relays; motor relay
*0609	Lamp and lamp units; lights and dome light
*0610	Sending units and warning switches
*0612	Batteries (12V-type 6TN) and battery cables
*0613	Wiring harnesses (hull, cab and power plant)
*0614	Electrical contact brushes and slip rings
*0616	Ventillating blower
*0617	Trailer electrical coupling
*0618	Rammer control assembly; cab power relay box; gunner's selector switch box; rammer switches and wiring harness; intercom wiring harness
0710	Transmission (model XTG-411-2A, Allison Div., GMC) and transmission seals, coupling shaft, brake and control valve
0711	Shifting controls and linkage/rod end brearing
0714	Control valve
0719	Trainer
0721	Transmission oil pump and filter
0801	Power transfer and final drive assemblies
1103	Final drive
1201	Hand brakes
1206	Mechanical brakes
*1301	Torsion bar
*1302	Road wheel and arm; hub brearing; hub bearing seal
*1303	Eccentric spindle control; spindle seal; track adjusting cylinder; idler arm and wheel; track idler support housing
*1304	Drive sprocket and hubs
*1305	Track and track shoes
1401	Steering controls
1503	Towing hooks; pintel
1604	Shock absorbers and road wheel arm bumper
1801	Cover plate and doors; travel lock
1802	Fender and track skirt
1803	Driver's hatch
1806	Seat
1808	Boxes, sockets and straps
1901	Tureet race
1903	Doors and ports
1904	Traversing mechanism and controls
1906	Internal and external stowage

* Improved RAM

1909	Rammer and spade hoist assembly
1910	Equilibrating elevating mechanism and controls
1920	Land Navigation System: Singer-Kearfott KHS-2100
1925	FM Radio: AN VRC-12
1930	Ammunition Autoloader: FMC design configured from MK 42 Mod 10 5"/54 gun mount (modified)
2005	Spade and spade lock
2205	Bilge pump
2207	Personnel heater; heater fuel filter, igniter and flame detector switch
2210	Vehicle data plate
2604	Cannon bore brush assembly
2801	Sighting and fire control equipment: Commander's periscope (M42) Panoramic telescope (M117) Panoramic telescope mount (M145) Direct fire telescope (M118C and M11CA1) Direct fire telescope mount (M146) Elevation quadrant (M15) Trunion bracket ring Infinity aiming reference collimator (M1) Carrying case (M82)
2810	Fire Control Computer: AN/AYK-14
3303	Winterization
3307	Deep water fording
3401	Cannon (M126A1/M185) 155mm and mount (M127)
3402	Machine gun .50 calibre (M2)
3403	RFire control
4309	Hydraulic equilibration system; primary and secondary accumulators
4701	Speedometer and speedometer drive components; tachometer and tachometer drive components
7639	Fixed (10 lb. bottle) system and portable (5 lb.) bottles
9501	Hardware supplied in bulk materials

APPENDIX A4
PERSONNEL DATA

This appendix describes the Army's Enlisted Master File (EMF) and the extract upon which the personnel analysis was based. The EMF contains current personnel data describing the status of all Army enlisted personnel. It is updated and maintained by the Army Military Personnel Center (MILPERCEN).

The extract from the EMF used for purposes of this study contains 43 data elements (the entire EMF contains approximately 225 elements) for each individual within 36 MOSs. Data were collected for these 36 MOSs prior to definitization of the group of eight MOSs which were to be analyzed for this study. Table A4-1 depicts the MOSs and data elements which comprise the EMF extract received from MILPERCEN.

Since MILPERCEN maintains historical snapshots of the EMF, it was possible to request four data extracts at once, for the current and previous three quarters. In addition, it was requested that there would be quarterly updates sent for the next year.

The data were, for the most part, complete and usable. The one exception is that the two fields of school history data were found to be incomplete. For example, for the Non-Commissioned Officer (NCO) Education System field, only 6% of all individuals had any code listed. A MILPERCEN EMF data base manager verified that the reason for this was that the information is not being reported to them by the

schools. Similary, Advanced Individual Training (AIT) graduation dates (1) do not contain the year of the graduation date, (2) are not properly reported, and (3) are incomplete in many cases. Because of these constraints, as mentioned in the text, career paths were dropped from the analysis at this point.

Table A4-1. Enlisted Master File Data Extract Received for ESPAWS Study.

MOS	Data Elements
05B	Social Security Number (SSN)
05C	Military Personnel Class
13B	Active—Inactive Indicator
13E	Sex of Service Member
13F	Service Component
13Y	Term of Service or Enlistment
13Z	Date of Expiration of Term of Service
26L	Basic Active Service Date
26Q	Date of Rank (Grade in which serving)
31E	Grade in which Serving — Abbreviation
31J	Grade in which Serving (Code)
31V	Type of Last Grade Change
31Z	Date of Last Grade Change
32Z	Armed Forces Qualification Test Percentile Score (AFQSC)
34G	Armed Forces Qualification Test Score Group (AFQG)
35B	NCO Education System
35E	Additional Skill Identifier
41C	Location Abbreviation, Current/Geopolitical
44B	Date of Last Permanent Change of Station
45D	Date Departed or Joined Current Command
45E	Location — Potential Gaining
45K	Paygrade
45L	Eligibility for Additional Pay
45N	PMOS — How Acquired
45R	Primary Military Occupational Specialty
45Z	Type of Last Change to PMOS
63B	Date of Last Change to PMOS
63C	PMOS — Evaluation Score
63D	Secondary Military Occupational Specialty
63E	Projected MOS
63F	Projected MOS Date (Year-Month)
63G	Movement Designator Code
63H	Year-Month Eligible to Return from Overseas
63N	Number of Times Enlisted/Reenlisted
63T	Year-Month Commenced Current Overseas Tour
63Z	AIT Graduation Date
	Progression Military Occupational Specialty — Primary
	Primary MOS in which Tested, SQ Designator
	PMOS Skill Qualification Test Score (SQT)
	Previous SSN Date of Change
	Social Security Number, Previous
	Control Date, SSN Change
	Unit Identification Code, O.M.

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APPENDIX B1
MAINTENANCE WORKLOAD DETERMINATION

B1.1 The Reliability, Maintainablity, and Cost Model (RMCM)

The Reliability, Maintinability, and Cost Model (RMCM) was developed by DRC as part of the Life Cycle Cost Impact Model (LCCIM) Modeling System. DRC developed RMCM under contract to the Air Force Human Resources Laboratory at Wright-Patterson AFB, Ohio. The initial application of RMCM was in a study on the Digital Avionics Information Subsystem. It was also used in the Coordinated Human Resources Technology (CHRT) Study to evaluate the system ownership cost of the avionics and landing gear for the Advanced Medium Shortrange Transport (AMST) aircraft.

RMCM is actually a model within a model. It is composed of a Reliability and Maintainability (R&M) Model with its associated data bank, and a Cost Model which uses both inputs and outputs of the R&M Model and a cost data bank. The RMCM is an analytical accounting cost model which computes the life cycle cost of any proposed design for a system.

The R&M model portion of RMCM operates in conjunction with a computerized data bank containing historical reliability and maintenance data gathered from operational systems. This data is made relevant to new systems by factoring the historical data on the basis of system/subsystem comparability analyses. Inputs to the R&M Model include the frequency of maintenance actions by subsystem, and task/event data for each maintenance action such as type,

probability of occurrence, average time to complete and manpower type and skill requirements.

The computed outputs of this model are expected values since they are based on average input values rather than peak demands or other constraints. These outputs are principally measures of the maintenance manhour resource requirements which may be expected to result under a given set of conditions. For this reason, DRC intended to use the R&M model portion of RMCM to calculate the maintenance workload requirements of the ESPAWS reference and conceptual designs.

However, upon examination of the data element inputs required for R&M, it was ascertained that R&M could not be used for the ESPAWS study effort. This was due to several factors:

- R&M is service specific in that it was developed for the Air Force.

- R&M is equipment specific in that it was developed for aircraft and aircraft-related applications.

- R&M is thus a model of a certain set of circumstances: that of Air Force aircraft maintenance. This reality is wholly different than the circumstances that exist for Army ground combat vehicles. For example, the Air Force has three echelons of maintenance while the Army has at least four; the Air Force maintenance philosphy is generally one of remove and replace with off-equipment repair of replaceable

components, while the Army is more oriented to repair in place with repair parts, not components.

- The data input requirements for the R&M Model reflected the availability of maintenance data according to the management needs of the Air Force. These data were thus the quantitative expression of the Air Force maintenance philosophy.

These factors led to the conclusion that the R&M portion of RMCM, as it existed, was unsuitable for application to ESPAWS. In order for R&M to have been applied, it would have had to undergo extensive internal modifications for it to properly depict the maintenance circumstances and philosophy of the Army. It would also have required data elements to be created, assumed, or extrapolated to satisfy those input requirements of R&M for which the Army does not require data to be collected.

B 1.2 Determining Maintenance Workload

The Field Artillery Sample Data Collection (SDC) data provided an excellent alternative method for determining maintenance workload. As the development of RMCM was predicated on the existence of data of certain types and characteristics, the method developed relied upon the data elements contained in the SDC.

The principal advantage of SDC data over its counterparts in the Navy and the Air Force was that each SDC maintenance incident was characterized by the specialty (MOS), grade,

and manhours of the personnel who provided the maintenance services. In the Navy applications of HARDMAN, the probability of maintenance events must be melded with task data through extensive task/event networks, which are then manipulated to derive workload. The SDC data afforded the opportunity to derive workload without extensive networking analyses. However, networking proved to be a valuable tool for depicting and ordering maintenance task/event relationships, even though the workload calculations proved to be much simpler.

The principal disadvantage of the SDC data was that the maintenance tasks were not described in greater detail, not only in contrast to the Air Force and Navy systems but even to generally accepted Army practice. For example, the SDC encompasses five task or maintenance action types, but the maintenance manual for the M109A1 predecessor system describes ten types of discrete maintenance tasks. Thus maintenance workload could only be characterized to the task level contained in the SDC; more detailed task descriptions would have resulted in a more sophisticated analysis.

In summary, by relying on the SDC data it was easier to construct a new method for calculating maintenance workload than to have used the existing R&M portion of RMCM. Figure B1-1 summarizes the logic of the DRC-developed maintenance workload calculations.

B1.3 DRC Modeling and Reporting Routines

Figure B1-2 depicts the DRC developed modeling and reporting routines which implements the logic for calculating

Figure B1-1 MAINTENANCE WORKLOAD CALCULATIONS

LOGIC:

$$\frac{\text{USE}}{\text{PERIOD}} \times \frac{\text{MAINTENANCE ACTIONS}}{\text{USE}} \times \frac{\text{MANHOURS}}{\text{MAINTENANCE ACTION}} = \frac{\text{MANHOURS}}{\text{PERIOD}}$$

PARAMETER:	INTENSITY	RELIABILITY	MAINTAINABILITY	WORKLOAD
DATA ELEMENTS:	PERIOD USAGE METRICS (MILES, ROUNDS, HOURS)	FREQUENCY OF MAINTENANCE ACTIONS BY SUBSYSTEM	MAINTENANCE ECHELONS MAINTENANCE TASKS ACTIVE MAINTENANCE TIME MAINTENANCE MANHOURS MOS OF PERSONNEL PAYGRADE OF PERSONNEL	MAINTENANCE MANHOURS: • BY ECHELON • BY SUBSYSTEM • BY MOS AND PAYGRADE
DATA SOURCES:	MISSION PROFILE/ OPERATIONAL MODE SUMMARY (MP/OMS)	SDC	SDC	

maintenance workload. The refined SDC data are contained in two files, /SPAWRED and /BASE. (See Appendix A2.4) These files are then manipulated (/GENMDL 1, 2, and 3) to create a model file for the predecessor M109A1 system. /GENMDL 4 allows application of percentage perturbation factors to the predecessor equipment to create temporary reference and conceptual system files. These files are then updated by adding or subtracting equipments by using the /MODMDL program. The resulting predecessor, reference, and conceptual system model files are input into the report generating routines (/MMHBYGG, /MMHBYMOS, and /AVLBYGG) to provide the desired outputs as shown. To generate a report, the user must input the file desired, the scenario in terms of the usage metrics of miles, rounds and hours, the maintenance type (scheduled or unscheduled) and whether a detailed or summary report is desired. Example outputs of the /MMHBYGG, /MMHBYMOS, and /AVLBYGG programs are shown in Tables B1-1, B1-2, and B1-3, respectively. A user's guide to the programs is contained in Appendix B2.

Figure B1-2 DRC MODELING AND REPORTING ROUTINES

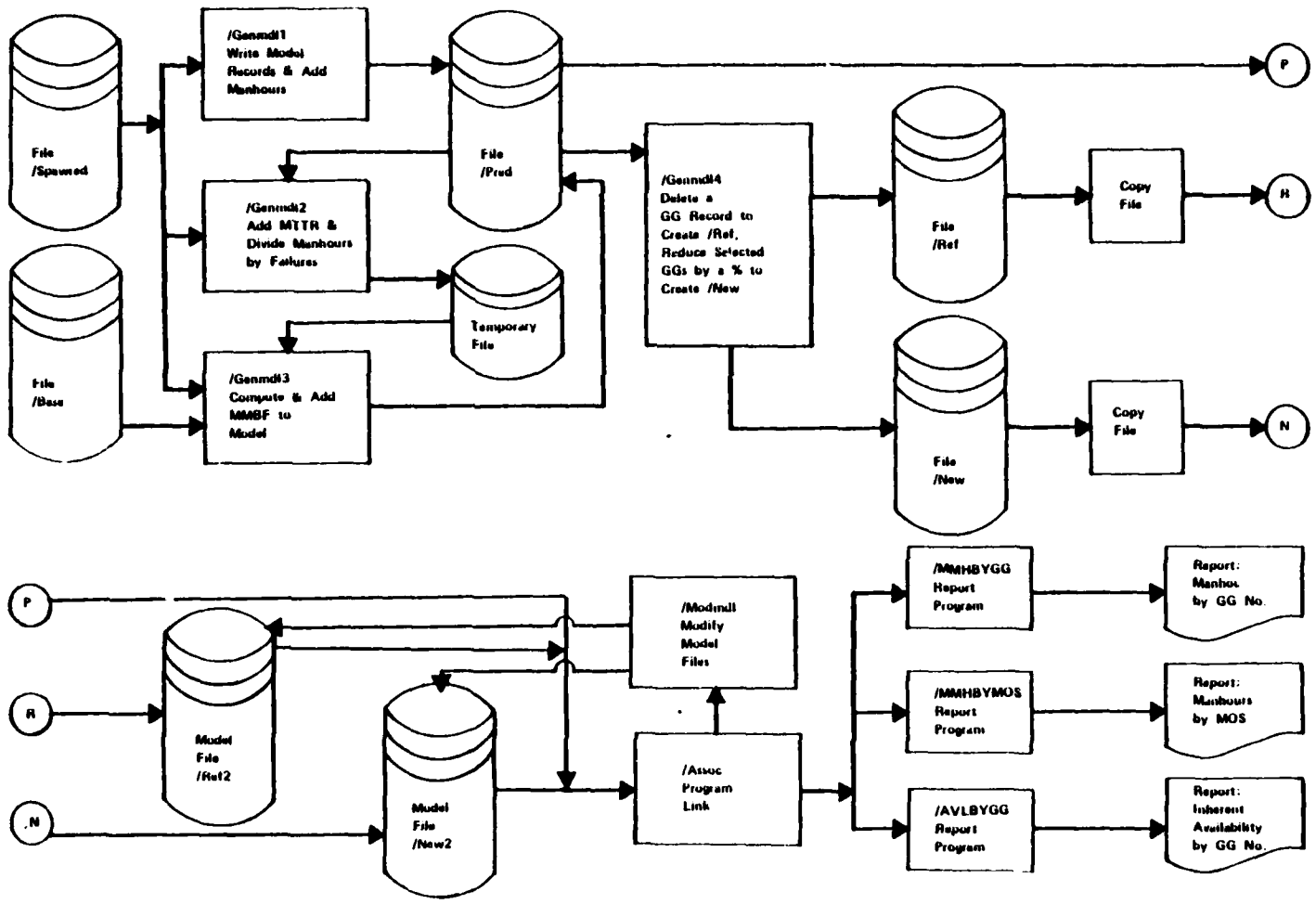

Table B1-1

EXAMPLE REPORT

MAINTENANCE MANHOURS ARRAYED BY GG NO. (MMHBYGG)

E S P A W S

P R E D E C E S S O R S Y S T E M

R E Q U I R E D U N S C H E D U L E D M A I N T E N A N C E M A N H O U R S

MILES = 15 ROUNDS = 300 HOURS = 24

	CREW			ORG			DIR			GEN			TOTAL		
	MMH	FAILURES	AVE	MMH	FAILURES	AVE	MMH	FAILURES	AVE	MMH	FAILURES	AVE	MMH	FAILURES	AVE
0614	000.08	000.07	01.1	000.15	000.07	02.1	000.04	000.07	00.5	000.00	000.07	00.0	0000.28	000.07	04.0
0618	000.34	000.27	01.2	000.28	000.27	01.0	000.15	000.27	00.5	000.01	000.27	00.0	0000.79	000.27	02.9
06 SUBTOTAL	000.42	000.34	01.2	000.43	000.34	01.2	000.19	000.34	00.5	000.01	000.34	00.0	0001.07	000.34	03.1
1204	000.00	000.00	02.0	000.00	000.00	00.0	000.00	000.00	01.0	000.00	000.00	00.0	0000.00	000.00	03.0
12 SUBTOTAL	000.00	000.00	02.0	000.00	000.00	00.0	000.00	000.00	01.0	000.00	000.00	00.0	0000.00	000.00	03.0
1901	000.00	000.00	00.0	000.00	000.00	02.0	000.00	000.00	00.0	000.00	000.00	00.0	0000.00	000.00	02.0
1904	000.93	000.58	01.6	001.26	000.58	02.1	000.58	000.58	01.0	000.63	000.58	01.0	0003.41	000.58	05.8
1909	000.19	000.14	01.3	000.20	000.14	01.4	000.16	000.14	01.1	000.10	000.14	00.7	0000.66	000.14	04.7
1910	000.39	000.10	03.9	000.89	000.10	08.9	000.23	000.10	02.3	000.32	000.10	03.2	0001.65	000.10	16.5
19 SUBTOTAL	001.51	000.82	01.8	002.15	000.82	02.6	000.97	000.82	01.1	001.05	000.82	01.2	0005.72	000.82	06.9
2005	000.11	000.04	02.7	000.05	000.04	01.2	000.00	000.04	00.0	000.00	000.04	00.0	0000.16	000.04	04.0
20 SUBTOTAL	000.11	000.04	02.7	000.05	000.04	01.2	000.00	000.04	00.0	000.00	000.04	00.0	0000.16	000.04	04.0
2604	000.05	000.03	01.6	000.03	000.03	01.0	000.02	000.03	00.6	000.01	000.03	00.3	0000.13	000.03	04.3
26 SUBTOTAL	000.05	000.03	01.6	000.03	000.03	01.0	000.02	000.03	00.6	000.01	000.03	00.3	0000.13	000.03	04.3
2800	000.05	000.06	00.8	000.06	000.06	01.0	000.08	000.06	01.3	000.03	000.06	00.5	0000.24	000.06	04.0
2801	000.11	000.11	01.0	000.14	000.11	01.2	000.09	000.11	00.8	000.03	000.11	00.2	0000.39	000.11	03.5
28 SUBTOTAL	000.16	000.17	00.9	000.20	000.17	01.1	000.17	000.17	01.0	000.06	000.17	00.3	0000.63	000.17	03.7
3401	001.14	000.43	02.6	001.15	000.43	02.6	000.61	000.43	01.4	000.43	000.43	01.0	0003.34	000.43	07.7
3403	000.03	000.04	00.7	000.03	000.04	00.7	000.03	000.04	00.7	000.01	000.04	00.2	0000.11	000.04	02.7
34 SUBTOTAL	001.15	000.47	02.4	001.18	000.47	02.5	000.64	000.47	01.3	000.44	000.47	00.9	0003.45	000.47	07.3

Table B1-2

EXAMPLE REPORT

MAINTENANCE MANHOURS ARRAYED BY MOS

(MMHBYMOS)

E S P A W S

REF2

R E Q U I R E D S C H E D U L E D M A I N T E N A N C E M A N H O U R S

MILES = 15 ROUNDS = 300 HOURS = 24

SPECIALTY	GRADE	CREW	ORG	DIR	GEN	TOTAL
12J	4	******.***	******.**2	******.***	******.***	******.**2
12U		******.***	******.**2	******.***	******.***	******.**2
13B	3	******.387	******.**4	******.***	******.***	******.391
13B	4	*****2.541	******.*12	******.***	******.***	*****2.553
13B	5	******.692	******.**6	******.***	******.***	******.698
13B	6	******.*63	******.**2	******.***	******.***	******.*65
13B		*****3.683	******.*24	******.***	******.***	*****3.707
16B	4	******.**2	******.***	******.***	******.***	******.**2
16B	6	******.**2	******.***	******.***	******.***	******.**2
16B		******.**4	******.***	******.***	******.***	******.**4
45K	4	******.***	******.*59	******.185	******.***	******.244
45K	5	******.***	******.*60	******.215	******.***	******.275
45K		******.***	******.119	******.400	******.***	******.519
45L	3	******.***	******.***	******.*42	******.***	******.*42
45L	4	******.***	******.***	******.452	******.***	******.452
45L	5	******.***	******.***	******.425	******.***	******.425
45L	6	******.***	******.***	******.*54	******.***	******.*54
45L		******.***	******.***	******.973	******.***	******.973
63C	3	******.**1	******.**5	******.***	******.***	******.**6
63C	4	******.***	******.136	******.***	******.***	******.136
63C	5	******.***	******.239	******.***	******.***	******.239
63C	6	******.***	******.*81	******.***	******.***	******.*81
63C		******.**1	******.461	******.***	******.***	******.462
63F	5	******.***	******.***	******.***	******.***	******.***
63F		******.***	******.***	******.***	******.***	******.***
TOTAL		*****3.688	******.606	*****1.373	******.***	*****5.667

Table B1-3

EXAMPLE REPORT: AVAILABILITY BY GG NO. (AVLBYGG)

E S P A - S

I N H E R E N T A V A I L A B I L I T Y

MILES = 15 ROUNDS = 300 HOURS = 24

GG #	PRED	REF	NEW
0100	0.996484	0.996484	0.998833
0101	0.999960	0.999960	0.999986
0102	0.999692	0.999692	0.999898
0103	0.999920	0.999920	0.999973
0105	0.999725	0.999725	0.999909
0106	0.999401	0.999401	0.999801
0108	0.999909	0.999909	0.999970
0109	0.999927	0.999927	0.999975
03	0.999996	0.999996	0.999996
0300	0.999971	0.999971	0.999975
0301	0.999786	0.999786	0.999818
0302	0.999694	0.999694	0.999741
0304	0.999569	0.999569	0.999635
0305	0.999407	0.999407	0.999497
0306	0.999273	0.999273	0.999384
0308	0.999951	0.999951	0.999958
0309	0.999759	0.999759	0.999796
0311	0.999981	0.999981	0.999984
0312	0.999858	0.999858	0.999880
0401	0.999833	0.999833	0.999833
05	0.999987	0.999987	0.999990
0501	0.998504	0.998504	0.998848
0503	0.999634	0.999634	0.999718
0504	0.999951	0.999951	0.999962
0505	0.998227	0.998227	0.998634
0507	0.999974	0.999974	0.999980
0601	0.998717	0.998717	0.999258
0602	0.998632	0.998632	0.999208
0603	0.998114	0.998114	0.998909
0607	0.999582	0.999582	0.999758
0608	0.998989	0.998989	0.999415
0609	0.999978	0.999978	0.999987
0610	0.999589	0.999589	0.999762
0612	0.998767	0.998767	0.999287
0613	0.999624	0.999624	0.999782
0614	0.990105	0.990105	0.990105
0618	0.975503	0.975503	0.975503
0701	0.999985	0.999985	0.999985

APPENDIX B2

ESPAWS HARDMAN MODEL

USER'S GUIDE

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ESPAWS HARDMAN MODEL

USER'S GUIDE

This document contains instructions for using the programs which maintain and report on the ESPAWS HARDMAN model.

The ESPAWS HARDMAN model consists of three primary files (Predecessor, Reference, and New), and as many secondary files as desired, using any filename, each holding a variation of the data contained in one of the primary files.

The data in all model files is organized by Government Functional Grouping Code (GG#). For a given GG#, there is one GG record containing name, number, and reliability information (MTTR, DEPENDENCY, and Mean Metric Between Failure) and multiple detail records, each specifying manhours required per associated GG failure, by Maintenance, Echelon, Maintenance Type, FCD, Specialty, and Grade.

This guide explains how to use three report programs (MMHBYGG, MMHBYMOS, AVLBYGG), a program to modify the model files (MODMDL), as well as descriptions of Time-Sharing-System (TSS) commands for file creation, deletion, and copying. For more complete explanations of TSS commands, see the TSS General Information Manual.

Creation of the three primary files is described separately. See ESPAWS HARDMAN MODEL PROGRAMMERS GUIDE.

ESPAWS HARDMAN MODEL
USER'S GUIDE

MANHOURS BY SPECIALTY REPORT (MMHBYGG)

1. Logon to accounts ESPAWS2.

2. /MMHBYGG filename,MILEs-nnn,ROUNds-nnn,HOURs-nnn,MTYPe-{SCHEduled | UNSCheduled},RTYPe-{DETAil | SUMMary}

   A. filename - Required. Must be first argument after program name. It is not a file string, but a filename only, of a file in catalog ESPAWS2/DATA.

Arguments B thru F are optional and may be entered in any order.

   B. MILEs-nnn - miles travelled by one vehicle in one year. Miles default = 1000

   C. ROUNds-nnn - rounds shot by one vehicle in one year. Rounds default = 750

   D. HOURs-nnn - operating hours of one vehicle in one year. Hours default = 150

   E. MTYPe-{SCHEduled | UNSCheduled} - determines maintenance type of report
   Mtype default = unscheduled

   F. RTYPe-{DETAil | SUMMary} - determines report type. Detail report presents hours by four-digit GG#. Summary report presents hours by two most significant GG# digits only.
   Rtype default = detail

Upper case letters must be typed exactly as shown when the option is used.

Lower case are optional and may be omitted.

ESPAWS HARDMAN MODEL

USER'S GUIDE

MANHOURS BY SPECIALTY REPORT (MMHBYMOS)

1. Logon to accounts ESPAWS2.

2. /MMHBYMOS filename,MILEs-nnn,ROUNds-nnn,HOURs-nnn,MTYPe-{SCHEduled / UNSCheduled},RTYPe-{DETAil / SUMMary}

   A. filename - Required. Must be first argument after program name. It is not a file string, but a filename only, of a file in catalog ESPAWS2/DATA.

Arguments B thru F are optional and may be entered in any order.

   B. MILEs-nnn - miles travelled by one vehicle in one year. Miles default = 1000

   C. ROUNds-nnn - rounds shot by one vehicle in one year. Rounds default = 750

   D. HOURs-nnn - operating hours of one vehicle in one year. Hours default = 150

   E. MTYPe-{SCHEduled / UNSCheduled} - determines maintenance type of report. Mtype default = unscheduled

   F. RTYPe-{DETAil / SUMMary} - determines report type. Detail report breaks specialties down by grade. Summary report gives hours by specialty only. Rtype default = detail

Upper case letters must be typed exactly as shown when the option is used.

Lower case are optional and may be omitted.

ESPAWS HARDMAN MODEL

USER'S GUIDE

INTERACTIVE UPDATE PROGRAMS (MODMDL)

1. Logon to account ESPAWS2.

2. CATA /DATA,s,a

3. CPY /DATA/source-filename;/DATA/destination-filename

4. /ASSOC name-of-file-to-be-modified

5. /MODMDL

EXPLANATIONS:

2. CATA is a TSS command that will list the files in a catalog. Since all model files must reside in ESPAWS2/DATA, by listing that catalog, you will get an instant inventory of all model files. This step is optional.

3. CPY is a TSS command which will copy the contents of one file into another. If the destination file does not exist, CPY will create it. This step is optional. Use it if you want to try some modifications without disturbing the files you already have. Use as a source file, the file which requires the fewest changes to be made into the hypothetical system you want to test.

ESPAWS HARDMAN MODEL

USER'S GUIDE

INHERENT AVAILABILITY BY GG# REPORT (AVLBYGG)

1. Logon to account ESPAWS2.

2. /AVLBYGG pred-filename,ref-filename,new-filename,MILEs-nnn,ROUNds-nnn,HOURs-nnn

Arguments A thru C are required and must be entered in the order listed below.

A. pred-filename - name of file to be used as Predecessor system for this report. The file must reside in catalog ESPAWS2/DATA.

B. ref-filename - name of file to be used as Reference system for this report. The file must reside in catalog ESPAWS2/DATA.

C. new-filename - name of file to be used as New system for this report. The file must reside in catalog ESPAWS2/DATA.

Arguments D thru F are optional and may be entered in any order.

D. MILEs-nnn - miles travelled by one vehicle in one year. Miles default = 1000

E. ROUNds-nnn - rounds shot by one vehicle in one year. Rounds default = 750

F. HOURs-nnn - operating hours of one vehicle in one year. Hours default = 150

Upper case letters must be typed exactly as shown when the option is used.

Lower case are optional and may be omitted.

4. /ASSOC is a command file which makes the association between the file code which the MODMDL program uses for I/O, and a real file residing on disc. By changing this association, the MODMDL program can be made to work with any file having the proper physical and logical organization, namely, any of the model files.

   This step is required and must be taken immediately before invoking the MODMDL program. If the MODMDL program begins by printing "MI?", it means that no association has been made, and the program does not know which file to work on. If this happens, hit the break key, use /ASSOC, and re-invoke /MODMDL.

   Make sure that you know which file is currently associated. If you want to make changes to file B, but file A is currently associated, when you run the MODMDL program, you will be making changes to file A.

5. /MODMDL - The following is a description of the options available with this program.

LIST(L) - Program will prompt for a GG#, and if found, will display its GG record, and all detail records, 20 at a time.

SEARCH(S) - You may specify a record to be searched for which will become the current record, if found. You may specify only GG#, in which case the program will look for a GG-record. By answering "Y" to the DETAIL question, you may specify ECHELON, and/or MTYPE, and/or FCD, and/or SPECIALTY, and/or GRADE. The program will search for a Detail record with the values you have specified. If found, that record becomes the current record. If not found, the program will tell you which of the specified values could not be located.

NEXT-REC(C/R) - The next record in the file will be displayed and will become the current record.

ADD(A) - You may add a GG record only, a GG record and associated detail records, or detail records only. GG records are inserted in the file according to collating sequence. Detail records are appended immediately after their associated GG record.

DELETE(D) - If the record is a detail record, you will delete the current record only. If the current record is a GG Record, all detail records associated with that GG will be deleted in addition to the GG record itself.

MODIFY(M) - This option allows you to modify the current record. If the current record is a GG Record, you will be presented with a list of fields which may be altered. For detail records, you may change HOURS/FAILURE only. When prompted for the new value, typing C/R will leave the old value unchanged. If a new value is input, the record will be displayed and you may choose to udpate the file or leave it unchanged.

ESPAWS HARDMAN MODEL

USER'S GUIDE

OTHER USEFUL TSS COMMANDS

1. REMC - This TSS command removes all associations between files and file codes. If after using the CPY command or /ASSOC command file, you get a message saying a file is busy, use this command and try again.

2. ACCE PF,/DATA/name-of-file-to-be-purged

   This TSS command will delete a file from the file system. You will have to use it if you run out of file space, but be careful. Once a file is deleted it is gone forever.*

3. ACCE MF,/DATA/name-of-file-to-be-changed,NEWNAME/new-name-of-file/

   If you want to rename a file, this is how to do it.

   You may name your files anything you'd like, but only the files named 'PRED', 'REF', or 'NEW' will have neatly centered headings on their reports.

*In an emergency, purged files can be restored by the operators.

APPENDIX B3

DESCRIPTION OF THE MINIMUM FLOW SOLUTION (MFS) MODEL

This appendix contains a description of the processes, use, and potential growth of the Minimum Flow Solution (MFS) model.

The MFS model is run interactively to determine personnel requirements and is based on two types of input:

1. Personnel flow characteristics as derived from the EMF and

2. Manpower requirements for all units.

It used the following procedure for this application to determine the initial fill and subsequent sustaining rate for meeting specific manpower requirements.

1. Compute percentage of individuals in each AFQT category group for each MOS. This represents the likelihood of an incoming individual being in a particular category, given the current distribution.

2. Compute the percentage of individuals who attrite and the percent who advance from each MOS/paygrade. This can be converted to a monthly value by dividing by the average length of time-in-paygrade.

3. Compute the average time-in-paygrade for each MOS/paygrade.

4. Assume that the input manpower requirements must now be met and begin to push individuals through, based on the derived flow characteristics for that MOS.

5. Once the highest level requirements are met, check to see that all below are met.

6. Compute the number of personnel which must be input per month to maintain the calculated values.

The MFS model allows for any number of paygrades within an MOS to be examined, and it provides for the elimination from consideration of paygrades which are non-existent or not to be analyzed. For example, all 13B personnel become 13Y at the E-8 level. Therefore, the model will be given orders to look at 13B only from E-1 to E-7. This can also be done if it is not desired to look beyond a particular paygrade. (Note: If there is a "0" requirement at the highest level and it is input to the model as such, there will be a value representing those personnel who are normally advanced to that paygrade simply because they cannot be held at a particular level indefinitely.)

Table B4-1 describes the prompts which occur during an execution of the model, and all of the appropriate responses which the user may provide. Most of the prompts are used for the purpose of sensitization of parameters.

Table B3-1

Instructions for the ESPAWS Minimum Flow Model:

In response to:	Enter:
MOS=	The desired MOS, or to end the program, enter nothing. An invalid MOS will cause the prompt to recur.
OUTPUT TYPE (1,2 OR BLANK) =	1 - to execute only the minimum flow portion of the program, reporting monthly recruit rates. 2 - to execute the attrite/advance percentages portion of the program on an annual basis. blank (or nothing) - to execute both 1 and 2.
CAT-PG=	Two characters specifying the sensitization to perform. The valid first characters are: P - to perturb attrite probability T - to perturb attrite time-in-paygrade V - to perturb advance time-in-paygrade M - to perturb mentality distribution. Any other character will cancel the sensitization feature (including blank) For P,T, and V, the second character is optional and must be a digit specifying the paygrade to which the sensitization is restricted. If left blank, sensitization will be performed across all paygrades. Specifying a paygrade outside the range of paygrades being analyzed will produce a do-nothing sensitization. If the first character is M, the second character is not used.
FRAC=	The fraction of sensitization. If .1 is entered, the resulting sensitizations will be -10% and +10%.
#LEVELS=	The number of paygrades which may "bleed down" in order to satisfy requirements of lower paygrades. If 0 (or blank) is entered, the bleed-down feature is not used.
REQD=	The list of manpower requirements. Nine values, separated by commas, specifying the requirements for each paygrade. A -1 deletes the paygrade from the analysis. Each number must be followed directly by a comma or contain a decimal point.
HEADER=	A meaningful title for each of the two sensitizations of the mentality distribution "Alpha".
1= 2= 3= 4= 5=	The fractions between zero and 1.0 which will be used in place of Alpha for each of the two sensitizations of the Mentality distribution. The sum of the five new values for Alpha must sum to 1.0

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There are many potential expansions and adaptations of the MFS model which could and/or may be done in the future.

- By using the entire EMF, any number of MOSs could be analyzed, including a potential aggregation of all systems that utilize the same MOSs.

- By supplementing personnel demand data with personnel projection data, impacts can be assessed.

- CONUS/overseas duty rotation patterns could be derived and analyzed for their unique flow characteristics.

- School career patterns could be derived if EMF elements were updated.

- Revision of the MFS model could produce a tool which could tell personnel managers the effects of varying policy prior to implementation.

It is important to stress that there are many potential uses of the EMF data base and the MFS model. A flexible, usable data base derived from the EMF could ultimately provide users with many types of information regarding assignment and management of personnel.

APPENDIX B4
MINIMUM FLOW SOLUTION (MFS) MODEL OUTPUTS

This appendix contains all of the outputs upon which Personnel Requirements Analysis was performed. Each run was done interactively by inputting the parameters described in Table B4-1, as necessary for the type of run.

The method for determining personnel differentials is as follows. For example, for the predecessor-conceptual comparisons, an initial run was made to determine the fill and sustaining requirements for the predecessor system. Then the difference between manpower requirements of the predecessor and conceptual systems was run through the model to determine only those extra or fewer required to support the conceptual system. The conceptual system requirements were determined through the addition or subtraction of the differential personnel requirements. This was the method used in the cases of MOSs with the same highest level requirement for the predecessor and conceptual systems. For cases where the highest level requirements differed, the actual conceptual system manpower values were used, since the result was the same as assessing the differential.

Included in this appendix is a page for each MOS within both comparisons: (1) predecessor-conceptual and (2) reference-conceptual.

Also included are outputs which demonstrate the capability of parameter sensitization. These outputs are primarily made to show how this analytic tool could ultimately be used

to identify ways of decreasing the personnel requirements, as well as allowing "what-if" types of questions to be answered.

The MOS 13B was used to demonstrate each type of sensitization currrently performable. No in-depth attempt was made to analyze these results at this time since they would be part of Impact and Tradeoff Analyses. However, some points to note follow:

- Changing the attrition rate by a small fraction produces more of an impact than changing the time-in-paygrade by a small fraction.

- Changing the AFQT distribution produced a change in the distribution of personnel requirements and recruit rate. Eventually this fact could be used to determine optimum distribution.

B4.1

PREDECESSOR/CONCEPTUAL

COMPARISON

PREDECESSOR

MOS= 13B
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,5832,3969,1944,1944,81,-1,-1.

MOS-13B REQUIRES 950.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	23582.1
E2	0.	23881.6
E3	5832.0	25593.4
E4	3969.0	11679.7
E5	1944.0	3585.3
E6	1944.0	1944.0
E7	81.0	452.5

−Δ CONCEPTUAL

MOS= 13B
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,1863,1944,0,0,0,-1,-1.

MOS-13B REQUIRES 158.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	3925.1
E2	0.	3974.9
E3	1863.0	4259.8
E4	1944.0	1944.0
E5	0.	596.8
E6	0.	323.6
E7	0.	75.3

+Δ CONCEPTUAL

MOS= 13B
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,0,0,81,0,0,-1,-1.

MOS-13B REQUIRES 21.5/MO.

PYGD	REQ.	PERSONNEL
E1	0.	532.8
E2	0.	539.6
E3	0.	578.2
E4	0.	263.9
E5	81.0	81.0
E6	0.	43.9
E7	0.	10.2

PREDECESSOR/CONCEPTUAL

MOS= 31V
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,81,81,0,0,0,0,-1.

MOS-31V REQUIRES 7.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	149.5
E2	0.	175.0
E3	81.0	218.5
E4	81.0	81.0
E5	0.	42.2
E6	0.	29.6
E7	0.	8.4
E8	0.	1.2

PREDECESSOR/CONCEPTUAL

MOS= 41C
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,81,0,0,0,-1,-1.

MOS-41C REQUIRES 6.6/MO.

PYGD	REQ.	PERSONNEL
E1	0.	96.3
E2	0.	88.9
E3	0.	85.0
E4	81.0	81.0
E5	0.	33.3
E6	0.	1.8
E7	0.	0.

PREDECESSOR/CONCEPTUAL

MOS= 44B
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,81,0,0,0,-1,-1.

MOS-44B REQUIRES 4.5/MO.

PYGD	REQ.	PERSONNEL
E1	0.	138.3
E2	0.	78.4
E3	0.	195.6
E4	81.0	81.0
E5	0.	51.8
E6	0.	22.8
E7	0.	6.8

PREDECESSOR

MOS= 45K
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,81,324,243,0,-1,-1,-1.

MOS-45K REQUIRES 54.5/MO.

PYGD	REQ.	PERSONNEL
E1	0.	1160.9
E2	0.	1037.9
E3	81.0	1318.6
E4	324.0	545.9
E5	243.0	243.0
E6	0.	72.9

CONCEPTUAL

MOS= 45K
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,81,486,324,0,-1,-1,-1.

MOS-45K REQUIRES 72.7/MO.

PYGD	REQ.	PERSONNEL
E1	0.	1547.9
E2	0.	1383.8
E3	81.0	1758.1
E4	486.0	727.9
E5	324.0	324.0
E6	0.	97.2

PREDECESSOR

MOS= 45L
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,162,81,0,-1,-1,-1.

MOS-45L REQUIRES 27.6/MO.

PYGD	REQ.	PERSONNEL
E1	0.	621.6
E2	0.	579.9
E3	0.	622.8
E4	162.0	259.6
E5	81.0	81.0
E6	0.	8.4

+Δ CONCEPTUAL

MOS= 45L
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,81,81,0,0,-1,-1,-1.

MOS-45L REQUIRES 8.6/MO.

PYGD	REQ.	PERSONNEL
E1	0.	194.0
E2	0.	180.9
E3	81.0	194.3
E4	81.0	81.0
E5	0.	25.3
E6	0.	2.6

PREDECESSOR/CONCEPTUAL

MOS= 63B
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,0,0,81,-1,-1,-1.

MOS-63B REQUIRES 25.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	805.7
E2	0.	867.6
E3	0.	910.3
E4	0.	457.3
E5	0.	196.1
E6	81.0	81.0

PREDECESSOR

MOS= 63C
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,81,81,81,0,-1,-1.

MOS-63C REQUIRES 95.8/MO.

PYGD	REQ.	PERSONNEL
E1	0.	1788.5
E2	0.	1636.2
E3	0.	2023.7
E4	81.0	702.0
E5	81.0	198.3
E6	81.0	81.0
E7	0.	24.1

+Δ CONCEPTUAL

MOS= 63C
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,0,81,0,0,-1,-1.

MOS-63C REQUIRES 39.1/MO.

PYGD	REQ.	PERSONNEL
E1	0.	730.7
E2	0.	668.5
E3	0.	826.8
E4	0.	286.8
E5	81.0	81.0
E6	0.	33.1
E7	0.	9.8

B4.2

REFERENCE–CONCEPTUAL

COMPARISON

REFERENCE

MOS= 13B
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,3888,2268,2025,1944,81,-1,-1.

MOS-13B REQUIRES 950.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	23582.1
E2	0.	23881.6
E3	3888.0	25593.4
E4	2268.0	11679.7
E5	2025.0	3585.3
E6	1944.0	1944.0
E7	81.0	452.5

+Δ CONCEPTUAL

MOS= 13B
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,81,0,0,0,0,-1,-1.

MOS-13B REQUIRES 3.0/MO.

PYGD	REQ.	PERSONNEL
E1	0.	74.6
E2	0.	75.6
E3	81.0	81.0
E4	0.	37.0
E5	0.	11.3
E6	0.	6.2
E7	0.	1.4

−Δ CONCEPTUAL

MOS= 13B
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,0,243,0,0,0,-1,-1.

MOS-13B REQUIRES 19.8/MO.

PYGD	REQ.	PERSONNEL
E1	0.	490.6
E2	0.	496.9
E3	0.	532.5
E4	243.0	243.0
E5	0.	74.6
E6	0.	40.4
E7	0.	9.4

REFERENCE

MOS= 31V
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,81,1134,1134,0,0,0,-1.

MOS-31V REQUIRES 194.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	4020.4
E2	0.	4705.1
E3	81.0	5875.2
E4	1134.0	2178.1
E5	1134.0	1134.0
E6	0.	797.2
E7	0.	225.5
E8	0.	31.4

CONCEPTUAL

MOS= 31V
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,81,81,0,0,0,0,-1.

MOS-31V REQUIRES 7.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	149.5
E2	0.	175.0
E3	81.0	218.5
E4	81.0	81.0
E5	0.	42.2
E6	0.	29.6
E7	0.	8.4
E8	0.	1.2

REFERENCE/CONCEPTUAL

MOS= 41C
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,81,0,0,0,-1,-1.

MOS-41C REQUIRES 6.6/MO.

PYGD	REQ.	PERSONNEL
E1	0.	96.3
E2	0.	88.9
E3	0.	85.0
E4	81.0	81.0
E5	0.	33.3
E6	0.	1.8
E7	0.	0.

REFERENCE/CONCEPTUAL

MOS= 44B
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,81,0,0,0,-1,-1.

MOS-44B REQUIRES 4.5/MO.

PYGD	REQ.	PERSONNEL
E1	0.	138.3
E2	0.	78.4
E3	0.	195.6
E4	81.0	81.0
E5	0.	51.8
E6	0.	22.8
E7	0.	6.8

REFERENCE/CONCEPTUAL

MOS= 45K
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,81,486,324,0,-1,-1,-1.

MOS-45K REQUIRES 72.7/MO.

PYGD	REQ.	PERSONNEL
E1	0.	1547.9
E2	0.	1383.8
E3	81.0	1758.1
E4	486.0	727.9
E5	324.0	324.0
E6	0.	97.2

REFERENCE

MOS= 45L
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,324,81,0,-1,-1,-1.

MOS-45L REQUIRES 34.5/MO.

PYGD	REQ.	PERSONNEL
E1	0.	775.8
E2	0.	723.7
E3	0.	777.3
E4	324.0	324.0
E5	81.0	101.1
E6	0.	10.4

+Δ CONCEPTUAL

MOS= 45L
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,81,0,0,0,-1,-1,-1.

OS-45L REQUIRES 3.6/MO.

PYGD	REQ.	PERSONNEL
E1	0.	80.8
E2	0.	75.4
E3	81.0	81.0
E4	0.	33.8
E5	0.	10.5
E6	0.	1.1

−Δ CONCEPTUAL

MOS= 45L
OUTPUT TYPE (1,2 OR BLANK) = 1
CAT-PG=
#LEVELS=
REQD= 0,0,0,81,0,0,-1,-1,-1.

MOS-45L REQUIRES 8.6/MO.

PYGD	REQ.	PERSONNEL
E1	0.	194.0
E2	0.	180.9
E3	0.	194.3
E4	81.0	81.0
E5	0.	25.3
E6	0.	2.6

REFERENCE/CONCEPTUAL

MOS= 63B
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,0,0,81,-1,-1,-1.

MOS-63B REQUIRES 25.2/MO.

PYGD	REQ.	PERSONNEL
E1	0.	805.7
E2	0.	867.6
E3	0.	910.3
E4	0.	457.3
E5	0.	196.1
E6	81.0	81.0

REFERENCE/CONCEPTUAL

MOS= 63C
OUTPUT TYPE (1,2 OR BLANK) =
CAT-PG=
#LEVELS=
REQD= 0,0,0,81,162,81,0,-1,-1.

MOS-63C REQUIRES 95.8/MO.

PYGD	REQ.	PERSONNEL
E1	0.	1788.5
E2	0.	1636.2
E3	0.	2023.7
E4	81.0	702.0
E5	162.0	198.3
E6	81.0	81.0
E7	0.	24.1

B4.3

SENSITIZATION EXAMPLES

Alter attrition rate by 10%.

```
MOS=  13B
OUTPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  P
FRAC=  .1
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
```

MOS-13B	NO SENSITIZATION	- 10.0%	+ 10.0%
	REQUIRES 21.0/MO.	REQUIRES 10.5/MO.	REQUIRES 50.6/MO.
PYGD REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1 0.	521.2	293.4	1126.4
E2 0.	527.8	304.2	1113.1
E3 50.0	565.7	332.6	1169.3
E4 40.0	258.1	152.2	537.6
E5 30.0	79.2	61.9	114.8
E6 20.0	43.0	39.3	51.2
E7 10.0	10.0	10.0	10.0

Alter attrition rate for paygrade 5 by 10%.

```
MOS=  13B
OUTPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  P5
FRAC=  .1
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
```

MOS-13B	NO SENSITIZATION	- 10.0%	+ 10.0%
	REQUIRES 21.0/MO.	REQUIRES 17.6/MO.	REQUIRES 25.9/MO.
PYGD REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1 0.	521.2	437.9	643.6
E2 0.	527.8	443.5	651.8
E3 50.0	565.7	475.3	698.5
E4 40.0	258.1	216.9	318.8
E5 30.0	79.2	76.5	86.7
E6 20.0	43.0	42.9	43.0
E7 10.0	10.0	10.0	10.0

Alter attrite time-in-paygrade by 10%.

```
MOS=  13B
OUTPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  T
FRAC=  .1
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
```

MOS-13B	NO SENSITIZATION REQUIRES 21.0/MO.	- 10.0% REQUIRES 23.2/MO.	+ 10.0% REQUIRES 19.2/MO.
PYGD REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1 0.	521.2	573.4	478.2
E2 0.	527.8	582.2	483.0
E3 50.0	565.7	622.3	518.9
E4 40.0	258.1	268.3	249.8
E5 30.0	79.2	84.0	75.3
E6 20.0	43.0	45.2	41.1
E7 10.0	10.0	10.0	10.0

Alter attrite time-in-paygrade for paygrade 5 by 10%.

```
MOS=  13B
OUTPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  T5
FRAC=  .1
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
```

MOS-13B	NO SENSITIZATION REQUIRES 21.0/MO.	- 10.0% REQUIRES 21.0/MO.	+ 10.0% REQUIRES 21.0/MO.
PYGD REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1 0.	521.2	521.2	521.2
E2 0.	527.8	527.8	527.8
E3 50.0	565.7	565.7	565.7
E4 40.0	258.1	258.1	258.1
E5 30.0	79.2	75.9	82.6
E6 20.0	43.0	43.0	43.0
E7 10.0	10.0	10.0	10.0

Alter advance time-in-paygrade by 10%.

```
MOS=  13B
  TPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  V
FRAC=  .1
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
```

MOS-13B	NO SENSITIZATION	- 10.0%	+ 10.0%
	REQUIRES 21.0/MO.	REQUIRES 21.1/MO.	REQUIRES 20.9/MO.
PYGD REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1 0.	521.2	473.8	568.2
E2 0.	527.8	478.5	576.8
E3 50.0	565.7	514.2	616.7
E4 40.0	258.1	248.9	267.3
E5 30.0	79.2	74.9	83.5
E6 20.0	43.0	41.0	45.0
E7 10.0	10.0	10.0	10.0

Alter advance time-in-paygrade for paygrade 5 by 10%.

```
MOS=  13B
OUTPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  V5
FRAC=  .1
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
```

MOS-13B	NO SENSITIZATION	- 10.0%	+ 10.0%
	REQUIRES 21.0/MO.	REQUIRES 21.0/MO.	REQUIRES 21.0/MO.
PYGD REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1 0.	521.2	521.2	521.2
E2 0.	527.8	527.8	527.8
E3 50.0	565.7	565.7	565.7
E4 40.0	258.1	258.1	258.1
E5 30.0	79.2	74.6	83.9
E6 20.0	43.0	43.0	43.0
E7 10.0	10.0	10.0	10.0

Change AFQT distribution.

```
MOS=  13B
OUTPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  M
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
OLD ALPHA:
   0.0138
   0.1008
   0.7368
   0.1471
   0.0016
FIRST SENS:
HEADER=  MORE 1'S
1=  .7368
2=  .1008
3=  .0138
4=  .1471
5=  .0016
LAST SENS:
HEADER=  MORE 5'S
1=  .0138
2=  .1008
3=  .0016
4=  .1471
5=  .7368
```

MOS-13B		NO SENSITIZATION REQUIRES 21.0/MO.	MORE 1'S REQUIRES 52.3/MO.	MORE 5'S REQUIRES 53.7/MO.
PYGD	REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1	0.	521.2	1398.2	427.7
E2	0.	527.8	1108.3	403.7
E3	50.0	565.7	2008.8	1416.1
E4	40.0	258.1	679.9	1013.8
E5	30.0	79.2	201.8	536.9
E6	20.0	43.0	101.9	225.3
E7	10.0	10.0	10.0	10.0

Change AFQT distribution.

```
MOS=  13B
OUTPUT TYPE (1,2 OR BLANK) =  1
CAT-PG=  M
#LEVELS=  0
REQD=  0,0,50,40,30,20,10,-1,-1.
OLD ALPHA:
   0.0138
   0.1008
   0.7368
   0.1471
   0.0016
FIRST SENS:
HEADER=  HIGH 1'S
1=  .4
2=  .15
3=  .15
4=  .15
5=  .15
LAST SENS:
HEADER=  HIGH 5'S
1=  .15
2=  .15
3=  .15
4=  .15
5=  .4
```

MOS-13B		NO SENSITIZATION REQUIRES 21.0/MO.	HIGH 1'S REQUIRES 36.3/MO.	HIGH 5'S REQUIRES 36.3/MO.
PYGD	REQ.	PERSONNEL	PERSONNEL	PERSONNEL
E1	0.	521.2	813.4	581.6
E2	0.	527.8	698.6	530.9
E3	50.0	565.7	1195.2	1044.6
E4	40.0	258.1	509.6	582.2
E5	30.0	79.2	186.2	262.0
E6	20.0	43.0	89.3	117.1
E7	10.0	10.0	10.0	10.0

APPENDIX C

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APPENDIX C1
EQUIPMENT PRESENTATION FORMATS

Figures C1-1, C1-2 through C1-4, and C1-5 through C1-7 display the hierarchical presentation formats developed for the ESPAWS predecessor, reference, and conceptual systems respectively. In the predecessor diagram, each major subsystem of the M109A1 is represented by an unshaded ellipse. In each reference format, equipments from the predecessor are indicated by unshaded ellipses and equipments from other existing systems are indicated by shaded ellipses. (By definition, the reference system must consist of existing equipments, either from the predecessor or other systems in the DoD/NATO inventory.)

The conceptual system format is similar to the reference format with two major changes: (1) equipments which are modifications of reference equipments are represented by circles and (2) "new" equipments (indicating use of an emerging technology) which were not present in the reference system are represented by squares. Existing equipments (i.e. is equipments taken directly from the reference system without modification) are again represented by unshaded ellipses (to indicate predecessor equipment) and shaded ellipses (to indicate other existing equipment).

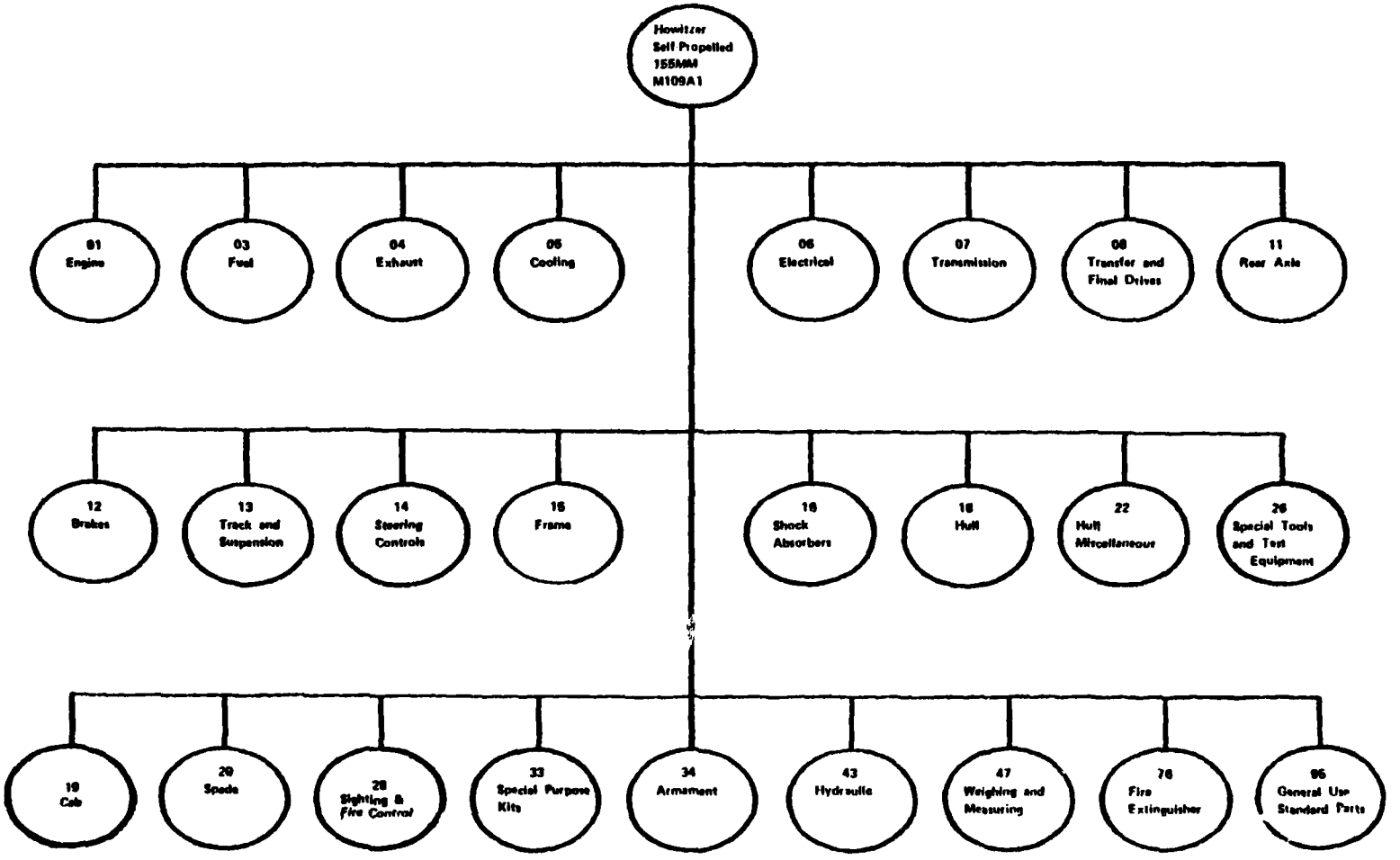

Figure C1-1 PREDECESSOR SYSTEM

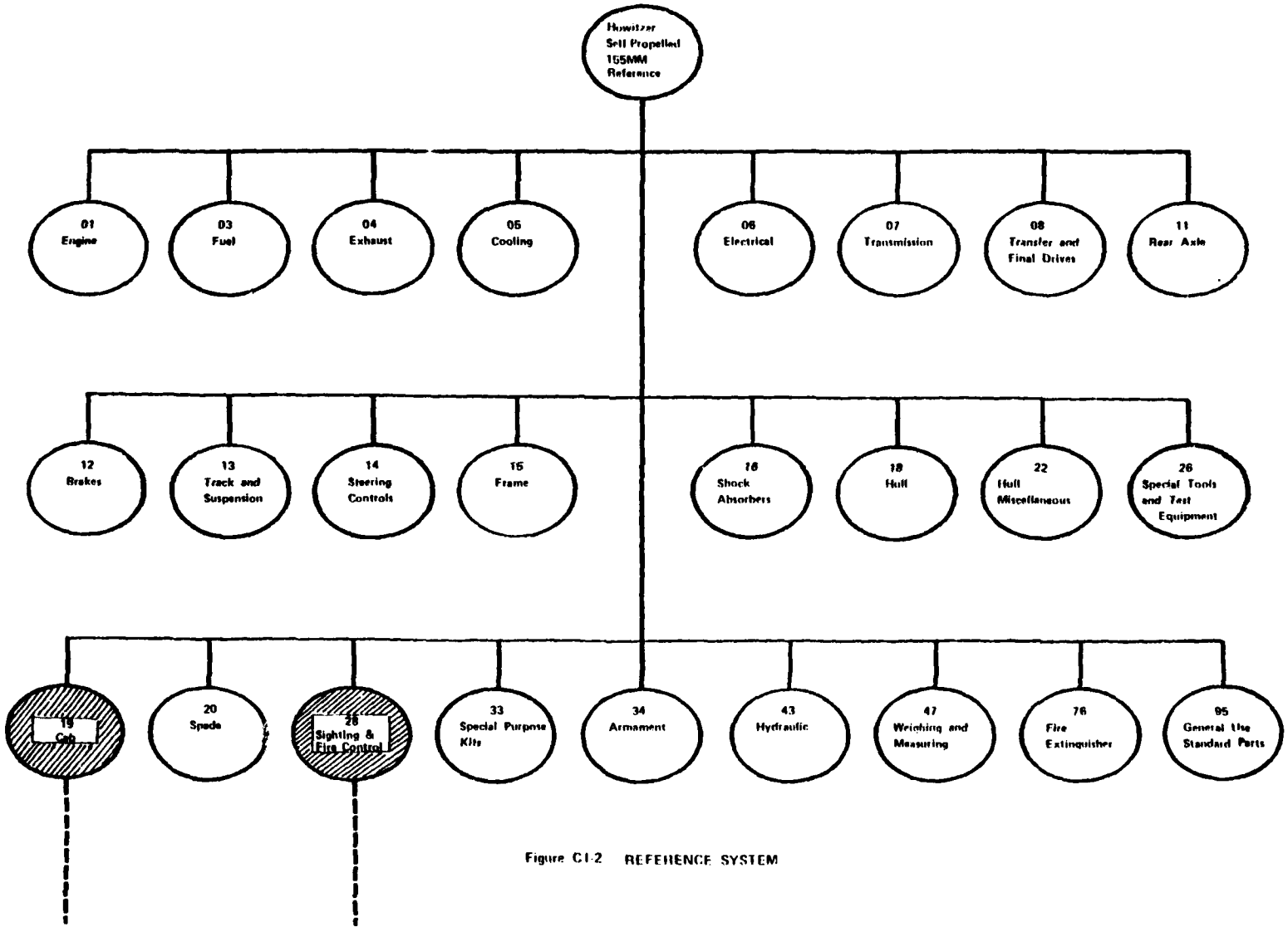

Figure C1-2 REFERENCE SYSTEM

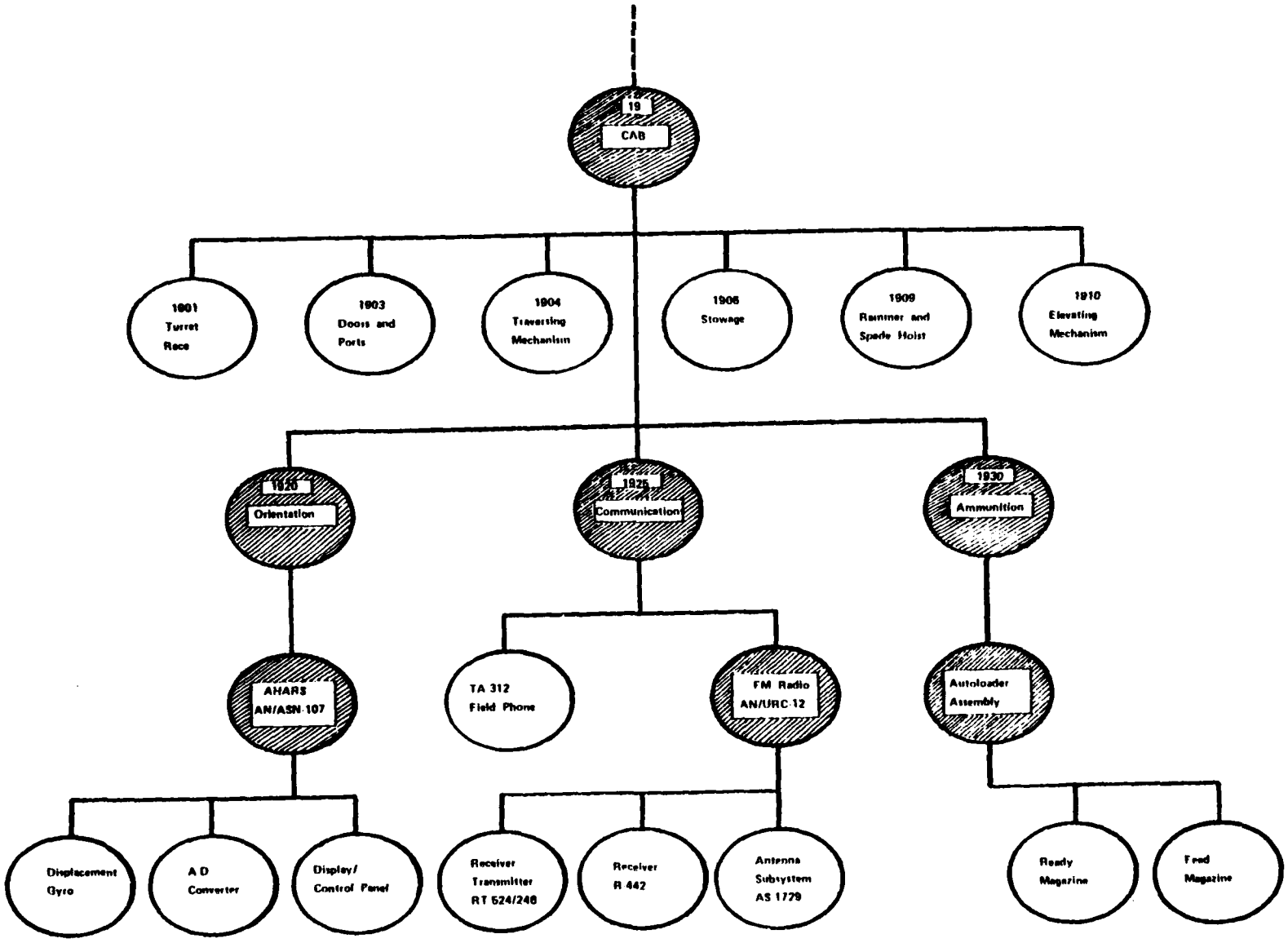

Figure C1-3 REFERENCE SYSTEM CAB

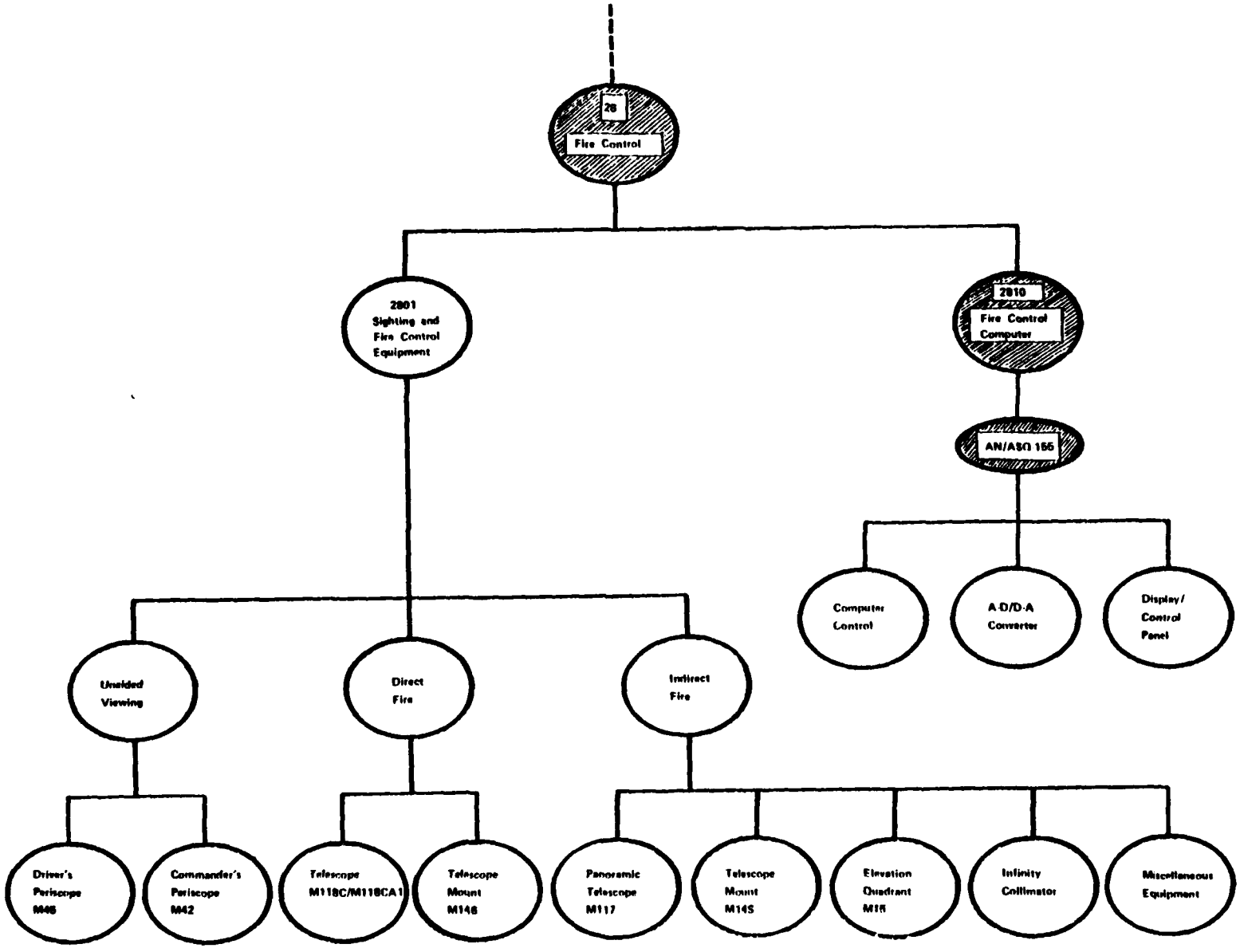

Figure C1 4 REFERENCE SYSREM FIRE CONTROL

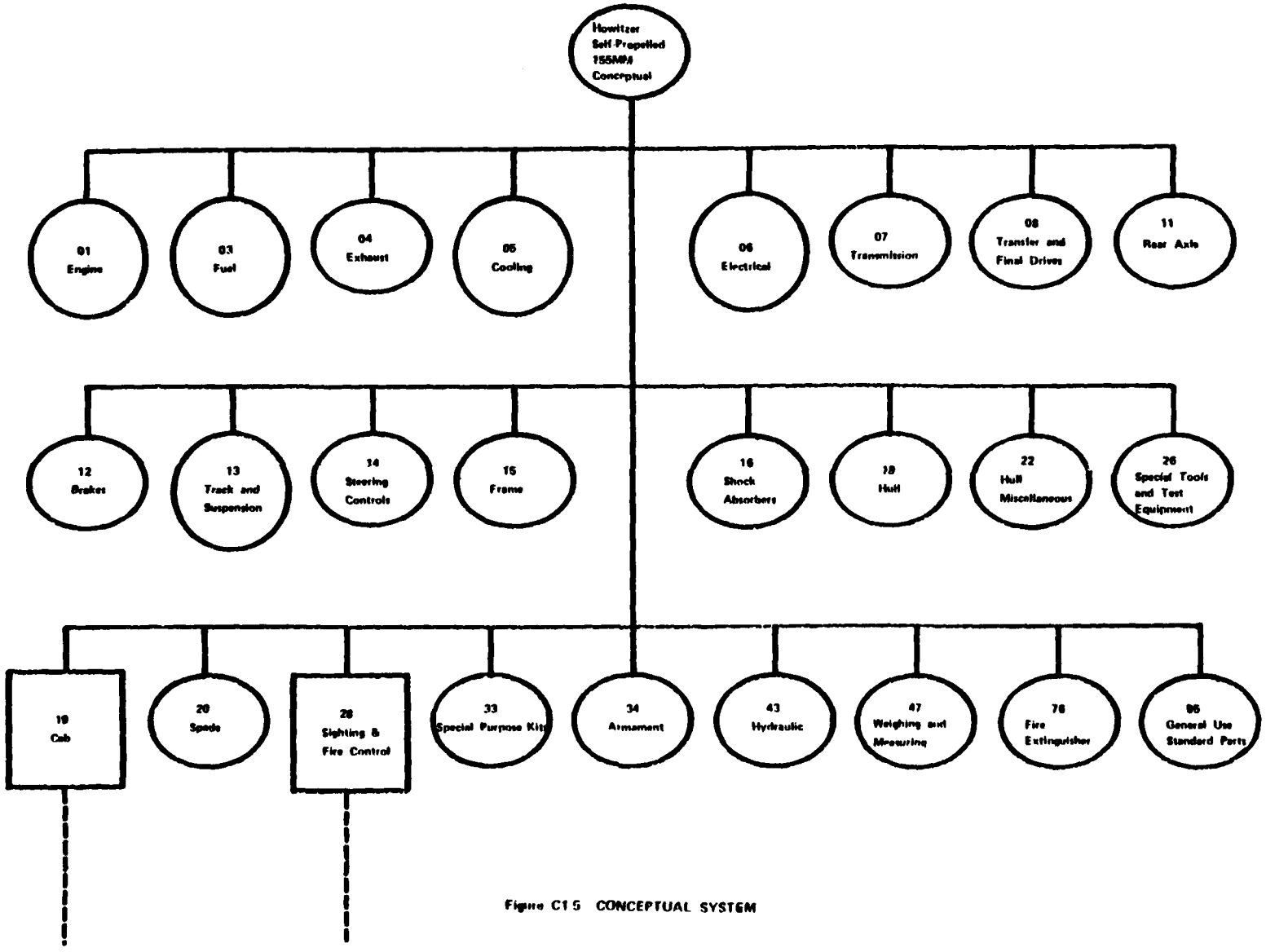

Figure C1.5 CONCEPTUAL SYSTEM

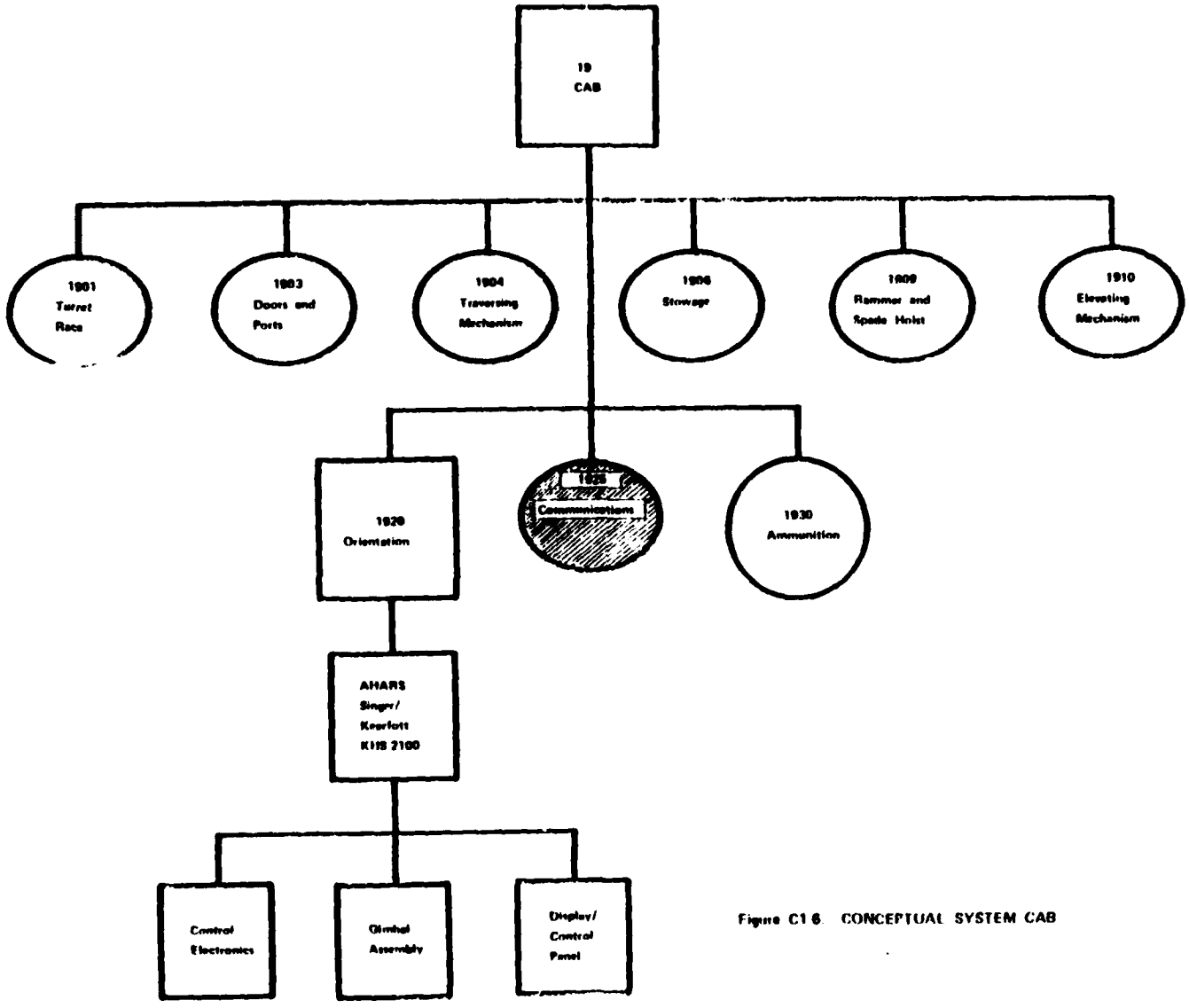

Figure C1.6. CONCEPTUAL SYSTEM CAB

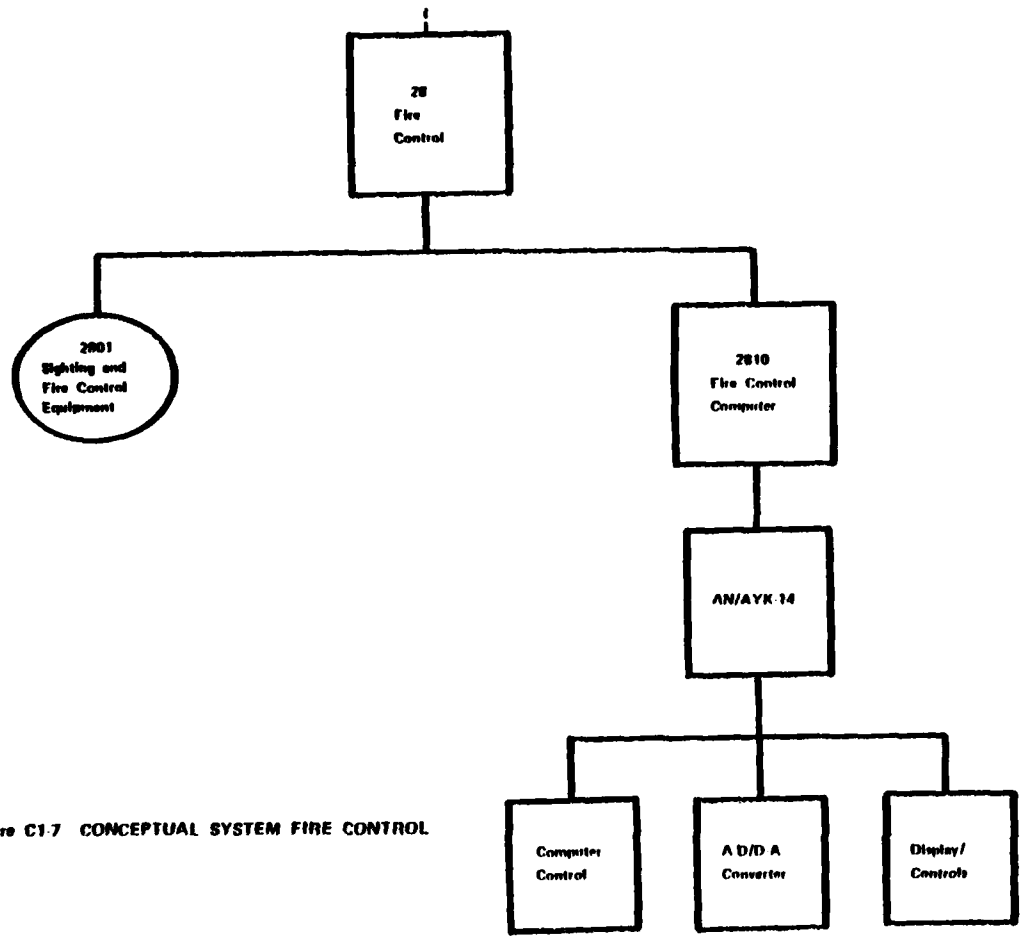

Figure C1-7 CONCEPTUAL SYSTEM FIRE CONTROL

APPENDIX C2

TASK DELETION/MODIFICATION AND TASK ADDITION WORKSHEETS

This appendix describes the worksheets that were used to describe the changes in task requirements associated with the ESPAWS reference and conceptual systems. These worksheets provide a documented audit trail for the reference task modification performed in Section 8.3.2.2 and the conceptual task modification performed in Section 8.3.2.3.

The appendix is divided into two sections. The first section describes the worksheets for modifications to existing tasks. The second section describes the worksheets for the additional tasks required by the ESPAWS reference and conceptual systems.

C2.1 Task Deletion/Modification Worksheets

Tables C2-1 to C2-6 display the worksheets for the modifications to the system-specific tasks associated with the reference equipments currently being maintained/operated by Army personnel. (Tasks associated with non-Army reference equipments are considered to be task additions) The worksheets indicate which of these system-specific tasks were deleted or modified and describe the type of task deletion or task modification associated with the task change. Task changes related to the conceptual system design changes are indicated by a "C" which is placed beside the task change code. Some tasks have two reference task change codes associated with them. This occurs when the same task must be performed both with the new automated

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET

MOS 13B COMMANDER'S MANUAL FM13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL LEVEL TRAINING	TRAINING RESPONSIBILITY: INSTITUTION: BCT	ATT/OBUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOUT	Self Study	Training	Established	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
Skill Level 1 Chapter 2: Common Tasks General Cannoneer																							
081 266 1101 (2 7)	Prepare a Position to Receive/Emplace a Cannon	FM 6-50	1		A						O	A	A		MAS	–	–	–	–	System1	–	R21 937-061-0030F R21 937 061-0031F R21 937 061-0032F Cover camoglage and Concealment Part 1,2 & 3	13B R-1
081 266-1103 (2 9)	Emplace/Recover Collimator	TM 9-1015-234-12 TM 9-2350-217-10N TM 9-2300-216-10	1		O						A	A	A		REL	–	–	4	3	Collimator		1 041-061-8081-J (111) Aiming posts and Collimator	13B-R 2
081 266 1104 (2 11)	Emplace/Recover Aiming Posts	FM 6-75 FM 6-91 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234 12 TM 9-2300-216-10	1		O						A	A	A		REL	–	–	4	3	Aiming Post	–	1 041-061-8081-3 (111) Aiming posts and Collimator	13B-R 2
081 266 1701 (2-13) (continued)	Establish and Maintain Communications with FDC	FM 6-50 FM 24-20 TEC Lesson 936-061-0125-F TEC Lesson 936-061-0126-F	1		O						A	A	A		MAJ	–	–	–	-	System	–	1 936-061-0108 F Initiating and responding to radio calls.	13B-R-3

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC - No Change in Task Required
MIN - Minor task modification: task essentially the same. Only minor change in equipment/nomenclature required
SKI - Skill level change - task essentially the same but assigned to different skill level
REL - Frequency change - same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ - Major task modification - task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM 6-13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SOMA	School	Service School	UNIT: SQT/T	Self Study	Training	Subsistence	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
081 266-1702 (2-14)	Monitor/Relay and Record Fire Commands	FM 6-50	1		O							A	A	A		MAJ	–	–	–	–	System	–	R21-936-081-0109-F thru R21-936-081-0114-F Pt 2 Writing down messages Pt 3 Responding to messages Pt 4 Preparing Messages to be sent Pt 5 Sending and receiving messages Pt 6 Enter and leave radio net Pt 7 Practice & self evaluation	13B-R-4
081 266-1215 (2-15)	Set/Lay the Cannon for Quadrant with the Range Quadrant	FM 6-75 FM 6-88 FM 6-94 TEC Lesson 041-081-6108-F TEC Lessons 041-081-6109-F thru 041-081-6164-F TM 9-1015-234-12 TM 9-2300-216-10 TM 9-2350-217-10N TM 9-1025-209-12	1				A	A				O	A	A		REL	–	–	4	3	Range Quadrant	–	1041-081-6108-F (111) laying for quadrant elevation	13B-R-2
081 266-1216 (2-17) (continued)	Measure the Quadrant with the Range Quadrant	FM 6-75 FM 6-88 FM 6-91 FM 6-94 TM 9-1015-234-12	1				A	A				O	A	A		REL	–	–	4	3	Range Quadrant	–		13B-R-2

TASK DELETION CODE

- ELI Elimination of Subsystem
- AUT Task Automation
- MTBF Increase in MTBF
- MP Change in Maintenance Policy
- O Other
- (C) Conceptual Addition

TASK MODIFICATION CODE

- NC – No Change in Task Required
- MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
- SKI Skill level change task essentially the same but assigned to different skill level
- REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
- MAJ Major task modification task characteristics (e.g., difficulty, importance) change
- (C) Conceptual Modification

FREQUENCY CODE

- 7 More than once a day
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- 1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM 6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	FNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SQT	Sustainment Training	Self Study	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
081-206-1217 (2-18)	Sight on a Target with a Direct Fire/Elbow Telescope (Except M114A1)	FM 6-75 FM 6-88 FM 6-94 TM 9-1015-234-12 TM 9-3004	1				A	A			O	A	A		MIN	–	–	–	–	Direct fire elbow telescope	–	1041-081-8931-J (111) Elevation Quadrant & Elbow telescope and mount	
081-206-1218 (2-19)	Fire the Cannon	FM 6-75 FM 6-81 TM 9-1015-234-12 TM 9-2300-216-10 TM 9-2350-217-10N TM 9-3004	1		O						A	A	A		MAJ + REL	– –	– –	– 4	– 3	System	–		13B-R-5 13B-R-2
081-206-1219 (2-20)	Clear Powder Chamber After Firing	FM 6-75 FM 6-81 FM 6-89 FM 6-90 FM 6-94 TM 9-1015-234-12	1		O						A	A	A		REL	– AVT	–	4	3	Powder Chamber	–		13B-R-2 DEL.
081-206-1517 (2-21) (continued)	Unload the Cannon (Separate Loading Ammunition)	FM 6-50 FM 6-81 FM 6-89 FM 6-94 TM 9-1025-200-12 TM 9-2300-216-10 TM 9-2350-217-[illegible]	1					A			O	A	A		MIN	–	–	–	–	System	–	1-041-081-8130F (111) Misfire of separate loading rounds	

TASK DELETION CODE

EEI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

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2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM 6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	BOMA	Service School	UNIT: BOLT	Self Study	Training	Scheduled	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
081 206-1220 (2 23)	Command "Check Firing" when Unsafe Conditions Exist	FM 6-50	1		O			A			A	A	A		NC	–	–	–	–	System	–		
	Cannoneer Maintenance																						
081 206-1401 (2 24)	Inspect and Clean Collimator	TM 9-1015-234-12 TM 9-1025-200-12 TM 9-2300-216-10 TM 9-2350-217-10N TEC Lesson 041-081-6081-J	1		O						A	A	A		REL	–	–	4	3	Collimator	–		13B-R-2
081 206-1402 (2 25)	Inspect and Clean Aiming Posts and Night Lighting Devices	TM 9-1025-200-12 TM 9-2300-216-10 TM 9-3004 TEC Lesson 041-081-6081-J	1		A						O	A	A		REL	–	–	4	3	Aiming Posts	–		13B-R-2
081 206-1403 (2 26) (continued)	Clean Cannon Tube and Chamber	LO 9-1015-203-10 LO 9-1025-200-10 LO 9-1030-203-10 LO 9-2300-216-12 LO 9-2350-217-12N LO 9-2350-304-12 TM 9-3004 TM 9-1015-234-12 TEC Lesson 041-081-6082-J	1		A		A				O	A	A		MIN	–	–	–	–	Cannon Tube	–		

TASK DELETION CODE

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AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

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FREQUENCY CODE

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2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOJT	Self Study	Training Schedules	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL TASK CHAR. SHEET
	Ammunition																					
551 721 1879 (2 27)	Operate the Material Handling Hoist on the M548 Cargo Carrier	TM 9 2350-247-10	1		A		A				O	A	A	NC	–	–	–	–	M548 Cargo Carrier	–	1 041 081-6140F (111) Introduction to Artillery Ammunition	
081 206 1501 (2 28)	Transport Cannon Ammunition on Vehicles	FM 6-50 TM 9-1300-206	1		A		A	A			O	A	A	NC	–	–	–	–	System	–		
081 206 1502 (2 30)	Prepare Cannon Ammunition for Helicopter Resupply	TM 55-450-11 TM 55-450-12	1				A	A			O	A	A	NC	–	–	–	–	System			
081 206 1504 (2 31)	Store Cannon Ammunition at a Cannon Position	FM 6-50 FM 6-75 TM 43-0001-28 TM 9-1300-206 TEC Lesson 041-081-6140-F	1		A		A	A			O	A	A		AUT	–	–	–	System	–		DEL.
081 206 1506 (2 33) (continued)	Prepare Separate Loading Ammunition for Firing	TM 9-1025-200-12 TM 43-0001-28 TM 9 2300-216-10 TM 9-2350-217-10N TM 9-3004 TEC Lesson 041-081-6140 F TEC Lesson 041-081-6141 F TEC Lesson 041-081-6143 F TEC Lesson 041-081-6144 F	1		O		A	A			A	A	A	MAJ	–	–	–	–	System	–	1041-081-6140 F (111) Intro to Artillery Ammunition 1041-081-6144-F Prep. Load, Fire Heavy Artillery Ammunition	13B-R 6

TASK DELETION CODE

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AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
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MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

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6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FMS 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SQMA	School Service	UNIT: SOPT	Study	Self Training	Scheduled Training	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
M109/m109A1																							
061 270 1601 (3-61)	Operate on M109/M109A1 Under Normal Conditions	TM 9 2350-217-10N TEC Lesson 945-171 0100-F	1								O	A	A		MIN	–		–		System			–
061 270 1208 (3 63)	Emplace/Recover Spades on the M109/M109A1	TM 9 2350-217-10N	1		O						A	A	A		MIN	–		–	–	Spades			
061 270 1204 (3 64)	Engage/Disengage Travel Lock on the M109/M109A1	TM 9 2350 217-10N	1		O						A	A	A		MIN	–	–	–	–	Travel Lock		1041-061 6036 J (111) Firing Jack & Travel Lock	
061 270 1501 (3 65)	Transport Cannon Ammunition on the M109/ M109A1	FM 6-50 FM 6-88 TMB-1300 206 TM 9-2350 217-10N	1								O	A	A		MAJ		–	–		Ammunition			13R R 7
061 270 1212 (3 66)	Boresight the Direct Fire Telescope on the M109/ M109A1 Using a Distant Aiming Point (DAP)	FM 6 88 TM 9 2350 217-10N	1				A	A			O	A	A		MIN	–	–	–		Direct Fire Telescope		R21 041 061-6170E (111) Boresighting the M109/M109A1	
061 270 1213 (3 67)	Boresight the Direct Fire Telescope on the M109/ M109A1 Using the Testing Target	FM 6 88 TM 9 2350-217 10N TEC Lesson 041-061 6119-F	1				A	A			O	A	A		MIN	–	–	–		Direct Fire Telescope		1041-061 6117 F (111) Boresighting tube 1041-061-6119F Boresighting Direct Fire Scope	

(continued)

TASK DELETION CODE

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MP Change in Maintenance Policy
O Other
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NC No Change in Task Required
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(C) Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOJT	Self Study	Scheduled Training	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR. SHEET
061 270 1514 (3 68)	Load a Prepared Round for Firing in the M109/ M109A1	TM 9-2350-217-10N	1		O						A	A	A	MAJ + REL	- -				System	-	1041 061 6133 J (111) Prefire Checks M109/ M109/A1 1041 061 6144 F Prep, Load Fire Heavy Artillery Ammunition 1041 061 6140 F Intro to Artillery Ammunition 1041 061 6141 F Artillery Fuses	13B-R 8 13B-R 2
061 270 1405 (3 70)	Clean Chamber Evacuator, Valves, and Muzzle Brake on the M109/M109A1	TM 9-2350-217-10N LO 9 2350 217 12N	1		A						O	A	A	MIN	-	-	-		Breech Mechanism		1041 061 6022 J M109 Evacuator Valves and Muzzle Brake	
061 270 1410 (3 72)	Assemble/Disassemble Breech and Firing Mechanism on the M109/ M109A1	TM 9 2350-217 10N	1								O	A	A	MIN	-	-			Breech Mechanism	-	1041 061 6026 5 (111) Breech Mechanism	
061 270 1407 (3 74) (continued)	Operate on M109/M109A1 Under Unusual Conditions	FM 31-70 FM 9-207 TM 9 2350-217 10N	1					A			O	A	A	MIN	-	-	-		System	-		

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
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TASK MODIFICATION CODE

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MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
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MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

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6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2 1 EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOJT	Self Study	Scheduled Training	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
	Radio/Telephone Operator																					
113 587 1004 (3 117)	Install Radio Set AN/VRC 46 (AN/VRC 12 Series)	TM 11-5820-401-12 TC 11-4 TC 11-6	1								O	A	A	MIN	–	–			AN/VRC IL	–		–
113 587 2003 (3 121)	Operate Radio Set AN/VRC 46 (AN/VRC 12 Series)	TM 11-5820-401-12 TEC Lesson 201-113-4545-A TEC Lessons 201-113-4550-E/A thru 201-113-4567-E/A TC 11-4 TC 32-11	1								O	A	A	MIN	–				AN/VRC 12	–		–
113 587 3004 (3 123)	Perform Operator Maintenance on Radio Sets AN/VRC 46 and AN/VRC 47	TM 11-5820-401-12 TM 38-750	1								O	A	A	MIN					AN/VRC 12	–		–
551 721 1002 (3 163)	Prepare DA Form 2404 (Equipment Inspection and Maintenance Worksheet)	FM 21-305 TM 38-750 TEC Lesson 510-091-6456-F	1								O	A	A	NC			–		System			
551 721 1003 (3 166)	Prepare DA Form 2408-1 (Equipment Dailor or Monthly Log) Daily	FM 21-305 TM 38-750	1								O	A	A	NC	–		–		System	–		

(continued)

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) Conceptual Addition

TASK MODIFICATION CODE

NC *No Change in Task Required*
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ *Major task modification task characteristics (e g. difficulty, importance) change*
(C) - Conceptual Modification

FREQUENCY CODE

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Table C2 1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	School	Service	UNIT: SOLT	Self Study	Scheduled Training	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR. SHEET
551 721 1007 (3 168)	Perform Before Operation Maintenance	Appropriate TM	1									O	A	A	MIN	-	-	-		System			
551 721 1008 (3 170)	Perform During Operation Maintenance	Appropriate TM	1									O	A	A	MIN		-	-		System			
551 721 1009 (3 172)	Perform After Operation Maintenance	Appropriate TM	1									O	A	A	MIN	-	-	-		System			
551 721 1013 (3 174)	Operate Vehicle in Snow	FM 21 305	1									O	A	A	MIN	-	-	-		System			
551 721 1014 (3 176)	Operate Vehicle in Sand	FM 21 305	1									O	A	A	MIN	-		-		System			
551 721 1015 (3 177)	Drive Vehicle Off Road	FM 21 305	1									O	A	A	MIN		-	-		System			
551 721 1016 (3 178)	Drive Vehicle in Motor March or Convoy	FM 21 305 FM 55 31	1									O	A	A	MIN	-	-			System			
551 721 1018 (3 190)	Drive Vehicle Under Blackout Conditions	FM 21 305	1									O	A	A	MIN	-	-	-		System			
551 721 1019 (3 193)	Drive Vehicle Through Contaminated Area	FM 21 305	1									O	A	A	MIN		-	-		System			
551 721 1834 (3 195)	Operate the Winch on a Wheeled Vehicle	Appropriate TM	1									O	A	A	MIN		-	-		System			
551 721 1877 (3 197)	Operate a Winch on an M548 Cargo Carrier	TM 9 2350 247 10	1									O	A	A	MIN					System			

(continued)

TASK DELETION CODE

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1 Less than once a year

Table C2 1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SQT	Study	Self	Training	Scheduled	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
061 266 1451 (3 265)	Perform Preventive Maintenance Checks and Services on a Howitzer or Gun	TM 9 1015-203-12 TM 9-1015-234-20P TM 9-1025-200-12 TM 9 2300 216 20 TM 9 2350-217 20N TM 9 3004 LO 9 1015-203-10 LO 9 1026 200-10 LO 9 1030-203 10 LO 9-2300-216-12 LO 9-2350 217 12N LO 9 2350-304-12	1							O	A	A	A		MAJ		-		-		Must Design Changes Related	Job Aids 1041 061 6022 thru 1041 061 6036	13B R 9
061 266 1452 (3 26R)	Purge and Change Fire Control Equipment	TM 750-116 TM 9 1015-203 12 TM 9 1015-234 20P TM 9-2300-216 20 TM 9 2350 217 20N	1							O	A	A	A		REL	-	-	4	3	Fire Control Equip			13B R 2
Artillery Mechanic (M109/M109A1)																								
061 270 1462 (3 284)	Adjust the Rammer Control Assembly on the M109/M109A1 Howitzer	TM 9 2350-217 20N	1							O	A	A	A		MAJ	-	-			Rammer Assembly		1041 061 6029 5 (111) Weapon Mounted Rammer	13B R 10
061 270 1463 (3 286) (continued)	Maintain the Power Pack Hydraulic System on the M109/M109A1 Howitzer	TM 9 2350-217 20N	1							O	A	A	A		MIN	-	-			Hydraulic Power Pack	-		

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
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MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SQUT	Study	Self Training	Scheduled	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR SHEET
061 270 1464 (3 288)	Repair Components of the Hydraulic Power Pack in the M109/M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							Q	A	A	A		MIN	–	–	–	–	Hydraulic Power Pack	–		
061 270 1465 (3 291)	Bleed and Charge the Elevating/Equilibrating Hydraulic Systems of the M109/M109A1 Howitzer	TM 9-2350-217-20N	1							Q	A	A	A		MIN	–	–	–	–	Equilibrating System	–		
061 270 1466 (3 293)	Repair of Components of the M109/M109A1 Howitzer Cab Electrical System	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							Q	A	A	A		MIN REL(C)	– –	– –	– 5	– 6	Electrical	– N06 4		
061 270 1467 (3 295)	Replace Solenoid or Combined Solenoid and Hydraulic Motor Bypass Valve in th M109/M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							Q	A	A	A		MIN	–	–	–	–	Solenoid			
061 270 1468 (3 297)	Replace Solenoid or Combined Solenoid and Rammer Control Valve in the M109/M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							Q	A	A	A		MAJ REL(C)	– –	– –	– 3	– 2	Solenoid	N06 4		13B R-11 13B C-1

(continued)

TASK DELETION CODE

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AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
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(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 138 COMMANDER'S MANUAL FM6 138/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SOMA	Service School	UNIT: SOUT	Self Study	Training	Scheduled	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL TASK CHAR SHEET
061 270-1469 (3 299)	Replace the Manual Elevation Accumulator Assembly in the M109/ M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							O	A	A	A		MIN	-	-	-	-	Manual Elevation Accumulator			
061 270-1470 (3 301)	Repair Gunner's Control or Cab Power Pack Tubes and Fittings to Gunner's Control on the M109/ M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							O	A	A	A		MIN	-	-	-	-	Gunner's Control			
061 270-1471 (3 303)	Check the Main Accumulator Nitrogen Precharged Pressure in the M109/M109A1 Howitzer	TM 9-2350-217-20N	1							O	A	A	A		MIN	-	-	-	-	Main Elevation Accumulator			
061 270-1472 (3 304)	Replace Solenoid or Combined Solenoid and Elevation Selector Valve in the M109/M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							O	A	A	A		MIN	-	-	-	-	Solenoid			
061 270-1473 (3 306) (continued)	Repair Hydraulic Tubes and Fittings to Elevation and Equilibrator Systems on the M109/M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							O	A	A	A		MIN	-	-	-	-	Hydraulic Tubes			

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FREQUENCY CODE

7 More than once a day
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2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM8 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SQT	Study	Self Training	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR. SHEET.
081-270-1474 (3-307)	Repair the Cab/Turret Wiring Harness of the M108/M108A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2	1							O	A	A	A		MIN REL(C)	- -	- -	- 3	- 2	Cab/Turret Wiring Harness	N06-4		13B-C-1
081-270-1461 (3-308)	Repair the Cannon Breech Mechanism on the M109/ M109A1 Howitzer	TM 9-2350-217-20N TM 9-2350-217-20P-2 TM 9-2350-217-25P/2 LO 9-2350-217-12N	1							O	A	A	A		MIN	-	-	-	-	Breech Mechanism	-	1041-061-6026-J (111) Breech Mechanization	
Gunner																							
081-266-2221 (2-35)	Lay the Cannon for Initial Direction of Fire	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234-12 TEC Lesson 041-081-6165-F TEC Lesson 041-081-6103-F TEC Lesson 041-081-6180-F	1					A			O	A	A		REL	-	-	4	3	System	-		13B-R-2

(continued)

TASK DELETION CODE

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- AUT Task Automation
- MTBF - Increase in MTBF
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TASK MODIFICATION CODE

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FREQUENCY CODE

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- 1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	School	Service	UNIT: SOUT	Study	Self Training	Scheduled	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
081 266 2223 (2-40) REL	Aline Collimator/Aiming Posts	FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234-12 TEC Lesson 041-061-6110-F TEC Lesson 041-061-6166-F	2					A				O	A	A		REL	–	–	4	3	Collimator/Aiming Posts	–	1041-061-6104F Laying for Deflection Pt 1 Basics 1041-061-6105F Laying for Deflection Pt 2 Aline on Collimator 1041-061-6106F Laying for Deflection Pt 3 Aline on Aiming Points	13B-R-2
081 266 2224 (2-42)	Boresight the Panoramic Telescope with the M140 Alinement Device	TM 9-1015-234-12 TEC Lesson 041-061-6126-F	2					A				O	A	A		NC	–	–	–	–	Panoramic Telescope	–	1041-061-6118F Boresighting Panoramic Telescope	

(continued)

TASK DELETION CODE

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O Other
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Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOJT	Self Study	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
061 266-2229 (2 43)	Set/Lay the Cannon for Deflection	FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TEC Lessons 041-061-6103-F thru 041-061-6107-F TEC Lessons 041-061-6160 F thru 041-061-6164-F *TM 9-1015-234-10* TM 9-1025-211-20 TM 9-2350-304-10	2					A			O	A	A	REL MAJ	– –	– –	4 –	3	System	--	1041-061 6104F (111) Laying for Deflection Pt 1 Through Pt 4 014 061 6107F	13B-R-2 13B-R-12
061 266-2230 (2 45)	Sight on a Target During Direct Fire with the Panoramic Telescope	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234-12	2					A			O	A	A	NC	–	–	–	--	Panoramic Telescope	--		

(continued)

TASK DELETION CODE

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Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	ALT/OBJT	PNCOC	BNCOC	ANCOC	SIGMA	Service School	UNIT: SOJT	Self Study	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL TASK CHAR. SHEET
061 266-2231 (2-48)	Refer the Piece	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TEC Lesson 041-061-6113-F	2					A			O	A	A	REL	–	–	4	3	System	–		13B-R-2
	M109/M109A1																					
061 270-2225 (3-77)	Boresight the Panoramic Telescope on the M109/M109A1 Using a Distant Aiming Point (DAP)	FM 6-88 TM 9-2350-217-10N	2								O	A	A	REL	–	–	4	3	Panoramic Telescope	–	R21-041-061-6170E Boresighting M109/M109A1	13B R 2
061 270-2228 (3-78)	Boresight the Panoramic Telescope on the M109/M109A1 Using the Testing Target	FM 6-88 TM 9-2350-217-10N TEC Lesson 041-061-6118-F	2								O	A	A	REL	–	–	4	3	Panoramic Telescope	–	R21-041-061-6130E Boresighting M109/M109A1	13B R 2

(continued)

TASK DELETION CODE

ELI Elimination of Subsystem
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MTBF Increase in MTBF
MP Change in Maintenance Policy
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FREQUENCY CODE

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Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued) .

MOS 13B COMMANDER'S MANUAL FM6 13P/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SQT	Self Study	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REF. TASK CHAR. SHEET
061 266 3304 (2 6)	Verify Emplacement of Aiming Points and Recording of Deflections	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234-12 TEC Lesson 041 061-6110-F TEC Lesson 041-061-6166-F	3				Q	A			A	A	A	REL	–	–			System	–	1041-061-6110F Establishing Aiming Points 3041 061-6088A Lay Battery by Aiming Point, Deflection 3041-061-6091A Report Adjusted Deflection 2041 061 6092 Laying Battery and Measuring and Reporting	13B R 2
061-305 6002 (2-8)	Control Movement of Vehicles Within a Position	FM 6-50	3				A	A			Q	A	A	MIN	–	–	–	–	System			
061-266 3305 (2 9)	Determine Site to Crest	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94	3				Q	A			A	A	A	NC	–	–	–	–	System	–	2041-061-6017-A Verify place crest range	
061 266 3312 (2 12)	Render Required Reports to FDC	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94	3				Q	A			A	A	A	MAJ	–	–	–	–	System	–	2041-061-6093-J Laying Battery and Measuring and Reporting	13B R 13

(continued)

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
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MP Change in Maintenance Policy
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Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOUT	Self Study	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR. SHEET.
061 202 1002 (2 13)	Camouflage/Conceal Equipment	FM 5-20 FM 7-7 TEC Lesson 937-061 0030-F	3				O				A	A	A	NC	–	–			System	–	R21937-061-0030F R21937-061-0031F R21937-061-0032F Cover, Camoflage and Concealment	
061 266 3313 (2 15)	Prepare a Range Card for a Cannon	FM 6-50 FT 105-H-7, C-2 FT 155 AM-1, C-2	3				A	A			O	A	A	MIN	–	–			System	–		
061 266 3314 (2 17)	Direct the Personnel of the Cannon Section During Indirect Fire Missions	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015 234-12 ARTEP 6-165 ARTEP 6-365	3				O				A	A	A	MAJ	–	–			System	–		13B R-14
061 266 3315 (2 19)	Determine that the Weapon is Safe to Fire	FM 6-50 TEC Lesson 041-061 6019 A	3				O	A			A	A	A	NC	–	–	–	–	System	–	1041-061-6019A Determine Weapon Safe to Fire	
061 266 3316 (2 21)	Conduct Fire on Prearranged Targets	FM 6-50	3				O				A	A	A	MIN	–	–	–	–	System	–		

(continued)

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Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/QM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SQT	Self Study	Scheduled Training	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR. SHEET
061-266-3317 (2 22)	Execute Zone and Sweep Fire Missions	FM 6-50 TEC Lesson 041-061-6014-A TEC Lesson 041-061-6015-A TEC Lesson 041-061-6016-A	3				O				A	A	A	NC	-	-	-	-	System	-	1041-061-6014 A 1041-061-6015 A 1041-061-6016 A Compute Zone Fire Mission Compute Sweep Fire Mission Compute Sweep and Fire Mission	13B R-2
061-266-3110 (2 23)	Perform Gunner's Quadrant Micrometer Test	FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234-12 TM 9-2300-216-10 TEC Lesson 041-061-6101-F	3				O	A			A	A	A	REL	-	-	4	3	System	-	1041-061-6101 F & 1041-061-6102 F Test of Gunner's Quadrant, Part 1 & 2	
061-266-3111 (2 24)	Perform Gunner's Quadrant End for End Test	FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234-12 TM 9-2300-216-10 TM 9-2350-217-10N TEC Lesson 041-061-6102-F	3				O	A			A	A	A	REL	-	-	4	3	System	-		13B-R-2

(continued)

TASK DELETION CODE

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AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
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Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SQT	Self Study	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
061 266 3318 (2 26)	Set/Lay for Quadrant with the Gunner's Quadrant	FM 6-75 FM 6-81 FM 6-88 FM 6-94 TEC Lesson 041-061-6163 F	3				O				A	A	A	REL	–	–	4	3	Gunner's Quadrant	–	Azimuth	13B-R 2
061 266 3319 (2 27)	Measure the Quadrant with the Gunner's Quadrant	FM 6-75 FM 6-81 FM 6-88 FM 6-94	3				O				A	A	A	REL	–	–	4	3	Gunner's Quadrant	–		13B-R 2
061 266 3320 (2 28)	Issue Fire Order for Direct Fire	FM 6-50 FM 6-75 FM 6-81 FM 6-88 FM 6-90 FM 6-94 TM 9-1015-234-12	3				O				A	A	A	NC	–	–	–		System	–		
061 266 3321 (2 31)	Take Immediate Action for Misfire	FM 6-50 TM 9-1015-234-12 TM 9-2350-217-10N TEC Lesson 041-061-6130-F TEC Lesson 041-061-6131 F	3				O	A			A	A	A	NC	–	–	–		System	–	1041-061-6130F Misfire of Seperate Loading Rounds	
061 266 3322 (2 37) (continued)	Direct the Personnel of the Cannon Section During Displacement	FM 6-50	3				O				A	A	A	MIN	–	–	–		System	–		

TASK DELETION CODE

FLI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SOMA	Service School	UNIT: SOJT	Self Study	Scheduled Training	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR. SHEET
061 266 3323 (2 39)	Maintain DA Form 2408-4	TM 38 750	3				O				A	A	A	NC	–	–	–	–	System			
061 306 6004 (2 41)	Perform Crater and Shell Fragment Analysis	FM 6-121	3				A				A	A	O	NC	–	–	–	–	System	–	1243 061 0200F 1243 061-0102F Crater Analysis Parts 1 & 2	
061 270 3310 (3 42)	Verify Boresight Performed on th M109/ M109A1 with the Testing Target	FM 6-88 TM 9 2350-217-10N TEC Lessons 041-061 6117-F thru 041-061 6119-F TEC Lesson 041-061 6170-F	3				A				O	A	A	MIN	–	–	–		Testing Target	–	R21041 061-6170E Boresighting M109/ M109A1	
061 270 3427 (3 44)	Perform Preventive Maintenance Checks and Services on the M109/ M109A1	TM 9-2350-217-10N LO 9 2350-217-12N	3				A				O	A	A	MAJ	–	–	–		System	Almost All Design Changes Are Related	1041 061 6022 thru 1041 061-6036 M109/M109A1 Crew Maintenance	13R 6 15
061 270 3424 (3-46) (continued)	Prepare the M109/M109A1 for Operations Under Unusual Conditions	FM 9 207 TM 9-2350-217-10N FM 31 70 FM 31 71 TEC Lesson 945 171 0101	3				A				O	A	A	MIN		–	–		System			

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same. Only minor change in equipment/nomenclature required
SKI - Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2.1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 13B COMMANDER'S MANUAL FM6 13B/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSJT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOJT	Self Study	Scheduled Training	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
061 270 3429 (3 48)	Adjust the Equilibrator on the M109/M109A1	TM 9-2350-217-10N	3				A				O	A	A	MIN	-	-	-	-	Equilibrator	-	1041-061-6024 Equilibrator Elevating & Traversing Mechanism	
061 270 3430 (3 49)	Perform Prefire Checks on the M109/M109A1	TM 9-2350-217-10N TEC Lesson 041 061 6132-J	3				A				O	A	A	MIN	-	-	-		System		1041-061-6132J Prefire Checks (M109)	
	M109																					
061 270 3307 (3 41)	Verify Boresight Performed on the M109/M109A1 Using a Distant Aiming Point (DAP	FM 6-88 TM 9-2350-217-10N	3				A				O	A	A	MIN	-		-		System	-	R21041-061-6170E Boresighting the M109 M109A1	

(continued)

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
FEL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2 1. EXISTING TASK DELETION/MODIFICATION WORKSHEET (concluded)

MOS 138 COMMANDER'S MANUAL FM6 138/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT/OSUT	PNCOC	BNCOC	ANCOC	SGMA	Service School	UNIT: SOUT	Self Study	Scheduled Training	TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
061 270 3431 (3 50)	Perform Fire Control Alinement Tests on the M109/M109A1	FM 6 88 TM 9 2350 217 10N TEC Lesson 041 061 6101 F TEC Lesson 041 061 6102 F TEC Lessons 041 061 6116 F thru 041 061 6121 F TEC Lesson 041 061 6125 F TEC Lesson 041 061 6170 E TEC Lesson 041 061 6173 E	3				A				O	A	A	REL	-	-	-		Fire Control		041 061 6101F Test of Gunner's Quadrant Pt 1 041 061 6102F Test of Gunner's Quadrant Pt 2 1041 061 6117F Boresighting Tube 1041 061 6118F Boresighting Panoramic Telescope 1041 061 6119F Boresighting Direct Fire Scope	138 R 2
061 270 3436 (3 54)	Perform Rammer Reliability Checks on the M109/M109A1	TM 9 2350 217 10N	3				A				O	A	A	MAJ		-			Rammer		1041 061 6029 J Weapon Mounted Rammer	138 R 16
061 270 3438 (3 55)	Adjust Operating Cam on the M109/M109A1	TM 9 2350 217 10N	3				A				O	A	A	MIN	-				Operating CAM			
061 270 3425 (3 56)	Perform the Weekly/ Monthly Lubrication on the M109/M109A1	TM 9 2350 217 10N LO 9 2350 217 12N	3				A				O	A	A	MAJ	-				System			138 R 17

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2.2. EXISTING TASK DELETION/MODIFICATION WORKSHEET

MOS 31V COMMANDER'S MANUAL FM11-31V/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BT/AIT OSUT	PLC	AN/COC	SPT SCH	USA SMA	SOUT		UNIT: Self-Study	SCD TNG	TCC	TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
113-574-2058	Operate Radio Test Set AN/VRM-11(*) to Test Modules in AN/VRC-12 Series Radio Sets	TM 11-5820-401-12 TM 11-6625-496-12 Task 113-623-3022	1	O					A		A		A	NC	-		-		AN/VRC 12	-	2101-113-7145 A (046) Test Operate AN/VRC 12	
113-587-0032	Systems Troubleshoot Radio Set AN/VRC 12 Including Control Frequency Selector C-2742/VRC to a Defective Component, Cable, or Accessory	TM 11-5820-401-12 Task 113-587-3028 Task 113-623-3022	1	O					A		A		A	NC	-		-		AN/VRC 12		3101-113-7147 A (046) Sys. Troubleshoot Radio in a Wheeled Vehicle	
113-587-1019	Verify Installation of Radio Set AN/VRC 12 in a Tracked Vehicle	TM 11-5820-401-12 Task 113-623-3022	1	O					A		A		A	NC	-				AN/VRC 12		2101-113-7144 A (046) Install AN/VRC 12	
113-587-3028	Evaluate the Operation of Radio Set AN/VRC 12	TM 11-5820-401-12 Task 113-623-3022	1	O					A		A			NC			-		AN/VRC 12	-	2101-113-7145 A (046) Test Operate AN/VRC-12	
113-587-3029 (continued)	Perform Organizational Quarterly Preventive Maintenance on Radio Set AN/VRC 12 (continued)	TM 11-5820-401-12 DA PAM 310-7 Task 113-623-3022	1						O		A			NC					AN/VRC 12		2101-113-7148 A (046) Perform Organizational QTRLY PM	

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-2. EXISTING TASK DELETION/MODIFICATION WORKSHEET (concluded)

MOS 31V COMMANDER'S MANUAL VM11-31V/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION							TRAINING RESPONSIBILITY: UNIT			TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
								BT/AIT OSUT			Self-Study	SCD TNG	TCC									
113 587 7029	Check Performance of Operator's Preventive Maintenance on AN/VRC-12 12 Series Radio Sets	Task 113-623-3022 TM 38-750 SSO 712 TM 11-5820-401-12	2					O		A		A	NC	–	–	–		AN/VRC 12	–	2101-113-7146-A (046) Perform Organizational QTRLY PM	
113 587 7040	Check Performance of Organizational Preventive Maintenance on AN/VRC-12 Series Radio Sets	TM 11-5820-401-12 TM 38-750 SSO 712 SSO 734 Task 113-587-3029 Task 113-623-3022	2					O		A		A	NC	–	–	–		AN/VRC 12	–	2101 113 7146-A (-46) Perform Organizational QTRLY PM	

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC - No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL - Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.,
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2 3 EXISTING TASK DELETION/MODIFICATION WORKSHEET

MOS 41C COMMANDER'S MANUAL FM9 41C/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT					UNIT: FOUT	TEC/COR/R		TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ.	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
TECHNICAL TASKS OFF CARRIAGE FIRE CONTROL INSTRUMENTS																						
091 41C 1401	Perform Torque Inspection of Infinity Collimator M1	TM 9-1240-324-35	1		I						R			REL			4	3	Infinity Collimator			41C-C 1
091 41C 1403	Charge Infinity Collimator M1 With Nitrogen	TM 9-1240-324-35 TM 750-116	1		I						R			REL			4	3	Infinity Collimator			41C C 1
091 41C 2404	Replace Rheostat in Remote Control Light Source of a Collimator	TM 9-1240-324-35 TM 750-116	2		I						R			REL			4	3	Infinity Collimator			41C C 1
091 41C 1445	Repair Aiming Post Light M14	TM 9-6015	1		I						R			REL			4	3	Aiming Post			41C C 1
091 41C 1571	Troubleshoot Cross-Level Mechanism in Fire Control Quadrant M15	TM 9-1290-322-35	1		I						R			REL			4	3	M15 Fire Control Quadrant			41C C 1
091 41C 2572	Replace Bent Wormshaft in Fire Control Quadrant M15	TM 9-1290-322-35	2		I						R			REL			4	3	M15 Fire Control Quadrant			41C C 1

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
Mp Change in Maintenance Policy
O Other
(C) = Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc
MAJ Major task modification task characteristics (e g difficulty, importance) change
(C) Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-3. EXISTING TASK DELETION/MODIFICATION WORKSHEET (concluded)

MOS 41C COMMANDER'S MANUAL FM9 41C/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT					UNIT: FOUT	TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
091 41C 1580	Troubleshoot Panoramic Telescope M115	TM 9 1240 292 34	1		I						R			REL			4	3	M115 Panoramic Telescope			41C-C-1
091 41C 1581	Charge Panoramic Telescope M115 With Nitrogen	TM 9 1240 292 34 TM 9 1240 292 50	1		I						R			REL			4	3	M115 Panoramic Telescope			41C-C-1
091 41C 1582	Replace Cracked Lens in Eyepiece of Panoramic Telescope M115	TM 9 1240 292 34 TM 9 1240 292 50	1		I						R			REL			4	3	M115 Panoramic Telescope			41C-C-1
091 41C 1600	Install Telescope Mount M145 in SP Howitzer M109	TM 9 2350 217 20	1		I						R			REL			4	3	Telescope Mount			41C-C-1
091 41C 1601	Synchronize Telescope Mount M145 in SP Howitzer M109	TM 9 2350 217 20	1		I						R			REL			4	3	Telescope Mount			41C-C-1
091 41C 3580	Supervise Final Inspection of Panoramic Telescope M115	TM 9 1240 292 34	3		I						R			NC					Panoramic Telescope			
091 41C 3581	Supervise Synchronizing of M145 Telescope Mount in M109 Self Propelled Howitzer	TM 9 2350 217 20	3		I						R			NC					Panoramic Telescope			

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-4. EXISTING TASK DELETION/MODIFICATION WORKSHEET

MOS 45K COMMANDER'S MANUAL FM9-45K/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT					UNIT: FOJT	TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
Perform Inspection and Supervise Support Maintenance of Howitzer, Medium, Self Propelled: 155MM, M109A1:																						
091 45K 3787	Remove and Install Components of Breech Mechanism	OS 45L207, Medium Self Propelled Artillery Maintenance TM 9-2350-217-20	3								R	R		MIN					Breech Mechanism			
091 45K 3768	Determine Serviceability of Cannon Tube Using a Pullover Gage	OS 45L202, Fundamentals of Artillery Systems and Components; TM 9-1000-202-35 TM 9-2350-217-34/2 TM 9-4933-200-35 TM 38-750	3								R	I		MIN					Cannon Tube		1643 091 5708 F (11R) Measuring and Evaluating Gun Tube Wear	
091 45K 3769	Supervise Removal and Installation of Cannon Tube (Quick Change)	OS 45L207, Medium Self Propelled Artillery Maintenance TM 9-2350-217-34/2	3								R	I		MIN					Cannon Tube			
091 45K 3770	Disassemble, Determine Repair, and Assemble Replenisher Assembly	OS 45L207, Medium Self Propelled Artillery Maintenance TM 9-2350-217-34/2	3								R	R		MIN					Replenisher			

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same. Only *minor change in equipment/nomenclature required*
SKI *Skill level change* task essentially the same but assigned to different *skill level*
REI Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.,
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) *Conceptual Modification*

FREQUENCY CODE

7 *More than once a day*
6 *Daily*
5 *Weekly*
4 *Monthly*
3 *Three to Six times a year*
2 *Once or twice a year*
1 *Less than once a year*

Table C2-4. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 45K COMMANDER'S MANUAL FM9-45K/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT					UNIT: FOJT	TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
091-45K 3771	Disassemble, Determine Repair, and Assemble Rammer Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2	3								R	R		MIN					Rammer			
091-45K 3772	Troubleshoot and Isolate Malfunctioning Components of Cab Electrical System	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-20	3								R	R		MIN REL			5	5	Cab Electrical	NO6-4	1642-091-5801-J (080) Tribsht Gun Traverse & Elevat. Control Circuit	
091-45K 3773	Supervise Removal and Installation of Hydraulic Powerpack	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2	3								R	I		MIN					Hydraulic Power pack			
091-45K 3774	Disassemble, Determine Repair, and Assemble Elevating Equilibrator Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2	3								R	R		MIN					Equilibrator			
091-45K 3775	Supervise Removal, Disassembly, Assembly, and Installation of Traversing Mechanism	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2	3								R	I		MIN					Traversing Mechanism			

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-4. EXISTING TASK DELETION/MODIFICATION WORKSHEET (concluded)

MOS 45K COMMANDER'S MANUAL FM9 45K/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materiels	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT					UNIT: FQUT	TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
091 45K 3776	Inspect and Determine Sequence for Repair of Hydraulic Powerpack, Gunner's Control, and Crib Hydraulic System	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2	3								R	R		MIN					Hydraulic			

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2.6. EXISTING TASK DELETION/MODIFICATION WORKSHEET

MOS 45L COMMANDER'S MANUAL FM9 45L/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT				UNIT: FQJT	TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET
HOWITZER, MEDIUM, SELF PROPELLED, 155MM, M109A1																					
Cannon Assembly																					
091 45L 1551	Remove and Install Components of Breech Mechanism	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9 2350 217 20	1		I					R	R		MIN.	–	–	–	–	Breech Mechanism	–		
091 45L 2552	Inspect Cannon Tube Using M2 Borescope	OS 45L202, Fundamentals of Artillery Systems and Components; TM 9 1000 202 35, TM 9 2350 217 34/2, TM 9 4933 200 35, TM 38 750	2			I				R	R		MIN	–	–	–	–	Cannon Tube	–	1643 091 5707 F (118) Cannon Bore and Powder Chamber Eval	
091 45L 2553	Determine Serviceability of Cannon Tube Using Pullover Gage	OS 45L202, Fundamentals of Artillery Systems and Components; TM 9 1000 202 35, TM 9 2350 217 34/2, TM 9 4933 200 35, TM 38 750	2			I				R	R		MIN.	–	–	–	–	Cannon Tube	–	1643 091 5708F (118) Measuring and evaluating gun tube wear	

(continued)

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.,
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2-5. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 45L COMMANDER'S MANUAL FM9 45L/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT				UNIT: FOJT	TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
091 45L 2554	Remove and Install Cannon Tube (Quick Change)	OS 45L207, Medium Self-Propelled Artillery Maintenance TM 9-2350 217 34/2	2			I				R	R		MIN.	–	–	–	–	Cannon Tube	–		
091 45L 2555	Remove and Install Cannon Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance TM 9-2350 217-20 TM 9-2350 217-34/2	2			I				R	R		MIN.	–	–	–	–	Cannon Assembly	–		
RECOIL MECHANISM																					
091 45L 1556	Disassemble and Assemble Counterrecoil Buffer Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance TM 9-2350-217 34/2	1		I					R	R		MIN.	–	–	–	–	Buffer Assembly	–		
091 45L 1557	Disassemble, Repair, and Assemble Replenisher Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance TM 9-2350 217 34/2	1		I					R	R		MIN.	–	–	–	–	Repair Recuperator Assembly	–		
091 45L 2558	Disassemble, Assemble, and Repair Recuperator Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350 217-34/2 TM 38-750	2			I				R	R		MIN.	–	–	–	–	Repair Recuperator Assembly	–		
091 45L 2559	Disassemble, Assemble, Inspect, and Repair Variable Recoil Group and Recoil Cylinder Assembly (continued)	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350 217 34/2 TM 38-750	2			I				R	R		MIN.	–	–	–	–	Recoil Cylinder	–		

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL - Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2 5 EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 45L COMMANDER'S MANUAL FM 9-45L/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT					UNIT: FOJT	TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST. FREQ.	NEW FREQ.	SUBSYSTEM	DESIGN CHANGE NO.	ADDITIONAL MEDIA	REL. TASK CHAR. SHEET.
091 45L 1560	Disassemble, Repair, and Assemble Rammer Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350 217-34/2	1		I						R	R		MIN.	-	-	-	-	Rammer Assembly	-		
091 45L 1561	Isolate and Repair Cab Electrical System by Tracing Circuits on Electrical Diagram and Using a Multimeter to Measure Voltage and Resistance	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9 2350 217-20	1		I						R	R		MIN. REL(C)	- -	- -	- 5	- 5	Cab Electrical	N06 4		
091 45L 1562	Remove and Install Hydraulic Powerpack	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2	1		I						R	R		MIN.	-	-	-	-	Hydraulic Powerpack	-		
091 45L 1563	Remove and Install Gunner's Control	OS 45L207, Medium Towed Artillery Maintenance; TM 9-2350-217-34/2	1		I						R	R		MIN.	-	-	-	-	Gunner's Control	-		
091 45L 2564	Disassemble, Repair, and Assemble Elevating Equilibrator Assembly	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350 217 34/2 TM 38 750	2			I					R	R		MIN.	-	-			Equilibrator Assembly			
091 45L 2565	Remove, Repair, and Install Components of Cab Race	OS 45L207, Medium Self-Propelled Artillery Maintenance, TM 9 2350 217 34/2, TM 38 750	2			I					R	R		MIN.	-	-	-		Cab Race			

(continued)

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O - Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2.5. EXISTING TASK DELETION/MODIFICATION WORKSHEET (concluded)

MOS 45L COMMANDER'S MANUAL FM 9-45L/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT					UNIT: FOJT	TEC/CORR		TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
091 45L 2566	Remove, Repair, and Install Traversing Mechanism	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2 TM 38-750	2			I					R	R		MIN.		-	-	-	Traversing Mechanism	-	1642 091 5801 J (080) Troubleshooting Gun Traverse and Elevat Control Circuit	
091 45L 2567	Repair Hydraulic Powerpack, Gunner's Control, and Cab Hydraulic System	OS 45L207, Medium Self-Propelled Artillery Maintenance; TM 9-2350-217-34/2 TM 38-750	2			I					R	R		MIN.	-	-	-	-	Hydraulic System			

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBI Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2 6. EXISTING TASK DELETION/MODIFICATION WORKSHEET

MOS 63C COMMANDER'S MANUAL FM9-63C/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT	FOJT				UNIT: TEC/CORR		TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
Technical Tasks																					
Maintenance of Tracked Vehicle Engines																					
091 63C 1665	Remove an M109 Howitzer Powerplant	TM 9 2350 217 20	1		I		R						MIN REL(C)	- -	-	- 4	- 3	Powerplant	N01 2		63C C 1
091 63C 1692	Service Engine Fuel Filters on M109 Howitzer	TM 9 2350 217 20	1		I		R						MIN		-	-		Fuel Filter	-		
091 63C 1693	Remove and Replace a Fuel Supply Pump on an M109 Howitzer	TM 9 2350 217 20	1		I		R						MIN	-	-	-	-	Fuel Pump	-		
091 63C 1694	Perform a Fuel Flow Test on an 8V71T Engine Fuel Pump in an M109 Howitzer	TM 9 2350 217 20	1		I		R						MIN	-	-	-		Fuel Pump	-		
091 63C 1712	Remove and Replace Coolant Radiator on an M109A1 Howitzer Engine	TM 9 2350 217 10, TM 9 2350 217 20	1	I			R						MIN REL(C)		- -	- 4	3	Radiator	N05 1 N05 2		63C C 1
091 63C 1696	Remove and Replace Air Cleaners on an M109A1 Howitzer	TM 9 2350 217 20	1		I		R						MIN REL(C)	-	-	5	- 4	Air Cleaners	N03 1		- 63C C 1

(continued)

TASK DELETION CODE

- ELI Elimination of Subsystem
- AUT Task Automation
- MTBF Increase in MTBF
- MP Change in Maintenance Policy
- O Other
- (C) - Conceptual Addition

TASK MODIFICATION CODE

- NC No Change in Task Required
- MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
- SKI Skill level change task essentially the same but assigned to different skill level
- REI Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
- MAJ Major task modification task characteristics (e.g. difficulty importance) change
- (C) Conceptual Modification

FREQUENCY CODE

- 7 More than once a day
- 6 Daily
- 5 Weekly
- 4 Monthly
- 3 Three to Six times a year
- 2 Once or twice a year
- 1 Less than once a year

Table C2 6. EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 63C COMMANDER'S MANUAL FM9 63C/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT	FOJT				UNIT: TEC/CORR			TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
091 63C 1729	Remove and Replace Starter on an BV71T Engine	TM 9-2300-216-20, TM 9-2350-217-20 TM 9-2350-238-20	1	1			R							MIN REL(C)		-	4	3	Engine Starter	NO6 1		63C C 1
Maintenance of Tracked Vehicle Track and Suspension Systems																						
091 63C 1771	Troubleshoot Suspension System on a Tracked Vehicle	Applicable vehicle TM, TM 38 750	1		1		R							NC REL(C)	-	- -	- 5	5	Suspension System	N13 1		
091 63C 1772	Inspect a Tracked Vehicle Suspension System	Applicable vehicle TM, TM 38 750	1		1		R							NC	-	-	-			-		
091 63C 1773	Repair Tracked Vehicle Suspension System	Applicable vehicle TM	1		1		R							NC REL(C)	- -	- -	- 5	5	Suspension System	N13-1		
091 63C 1775	Remove and Replace a Torsion Bar on an M109A1 Howitzer	TM 9-2350-217 10, TM 9 2350 217 20	1		1		R							MIN		-	-		Torsion Bar	-		
091 63C 1776	Remove and Replace Drive Sprockets on an M109 Howitzer	TM 9-2350-217 10, TM 9 2350 217 20	1		1		R							MIN	-	-	-		Drive Sprockets	-		
091 63C 1778	Adjust Track	TM 9 2320 222 10	1		1		R							NC	-	-	-	-	Track	-		
091 63C 1779	Remove Track	TM 9-2320-222 10	1		1		R							NC	-	-			Track	-		
091 63C 1780 (continued)	Install Track	TM 9 2320 222 10	1		1		R							NC	-		-		Track	-		

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g., difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2 6 EXISTING TASK DELETION/MODIFICATION WORKSHEET (continued)

MOS 63C COMMANDER'S MANUAL FM9 63C6CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT	FOJT				UNIT: TEC/CORR		TASK MOD CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	REL TASK CHAR SHEET
Maintenance of Tracked Vehicle Hulls and Components																					
091 63C 1792	Remove and Replace Winch Wire Rope	TM 5 725, TM 9 2350 238 10	1	I			R						NC	-				Winch Wire Rope			
091 63C 1798	Troubleshoot Personnel Heaters	TM 9 2300 257 20, TM 11 6625 366 15	1	I			R						NC					Personnel Heaters			
091 63C 3863	Supervise Inspection, Troubleshooting, and Maintenance of Tracked Vehicle Engines	OS 63C201 FM 9 63C 1/2 TM 38 750 Applicable tracked vehicle TM	3		I		R				R		NC					Engine			
091 63C 3864	Supervise Inspection and Maintenance of Tracked Vehicle Air Induction and Exhaust Systems	FM 9 63C 1/2 Applicable tracked vehicle TM TM 38 750	3		I		R						NC	-		-		Engine			
091 63C 3865	Supervise Inspection and Maintenance of Tracked Vehicle Cooling Systems	FM 9 63C 1/2, Applicable tracked vehicle TM, TM 38 750	3		I		R						NC			-		Cooling System			
091 63C 3866	Supervise Inspection, Troubleshooting, and Maintenance of Tracked Vehicle Electrical Systems	FM 9 63C 1/2 Applicable tracked vehicle TM, TM 38 750	3		I		R						NC			-		Electric Systems			

(continued)

TASK DELETION CODE

FEI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REF Frequency change same task but task is performed more (less) frequently due to change in reliability, etc
MAJ Major task modification task characteristics (e g difficulty importance) change
(C) Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

Table C2.6 EXISTING TASK DELETION/MODIFICATION WORKSHEET (concluded)

MOS 63C COMMANDER'S MANUAL FM9 63C/CM

TASK NUMBER	TASK DESCRIPTION	PRIMARY TRAINING Materials	INITIAL TRAINING LEVEL	TRAINING RESPONSIBILITY: INSTITUTION: BCT	AIT	PLC/PTT	FOJT				UNIT: TEC/CORR			TASK MOD. CODE	TASK DELETION CODE	NEW SKILL LEVEL	EXIST FREQ	NEW FREQ	SUBSYSTEM	DESIGN CHANGE NO	ADDITIONAL MEDIA	RFL TASK CHAR. SHEET
091 63C 3867	Supervise Inspection, Troubleshooting, and Maintenance of Tracked Vehicle Power Trains and Brake Systems	OS 729 FM 9-63C 1/2 Applicable tracked vehicle TM, TM 38-750	3		I		R				R			NC	–	–	–		Power Train			
091 63C 3868	Supervise Inspection, Troubleshooting, and Maintenance of Tracked Vehicle Track and Suspension Systems	OS 85, OS 729 FM 9-63C 1/2 Applicable tracked vehicle TM, TM 38-750	3		I		R				R			NC	–	–	–		Track and Suspension			
091 63C 3869	Supervise Inspection, Troubleshooting, and Maintenance of Tracked Vehicle Hulls and Component Components	OS 729, FM 9-63C 1/2 Applicable tracked vehicle TM, TM 38-750	3		I		R				R			NC	–	–	–		Hulls and Components	–		
091 63C 3870	Supervise Maintenance and Troubleshooting of Tracked Recovery Vehicle Hydraulic Systems	OS 729 FM 9-63C 1/2 Applicable tracked recovery vehicle TM, TM 38-750	3		I		R				R			NC			–		Hydraulic Systems	–		

TASK DELETION CODE

ELI Elimination of Subsystem
AUT Task Automation
MTBF Increase in MTBF
MP Change in Maintenance Policy
O Other
(C) - Conceptual Addition

TASK MODIFICATION CODE

NC No Change in Task Required
MIN Minor task modification task essentially the same Only minor change in equipment/nomenclature required
SKI Skill level change task essentially the same but assigned to different skill level
REL Frequency change same task but task is performed more (less) frequently due to change in reliability, etc.
MAJ Major task modification task characteristics (e.g. difficulty, importance) change
(C) - Conceptual Modification

FREQUENCY CODE

7 More than once a day
6 Daily
5 Weekly
4 Monthly
3 Three to Six times a year
2 Once or twice a year
1 Less than once a year

equipment projected for ESPAWS and in the current manual mode (when the automated equipment breaks down). The manual performance of the task will not have to be performed as frequently as it currently is being performed; hence, it is marked by the "REL" code indicating only a change in task frequency is required. The automated performance of the task will be substantially different from the manual; hence it is marked by the "MAJ" code indicating a major task modification is required.

In addition to the task deletion/modification codes, the following information is listed for each task: (1) the initial skill level for which the task is trained; (2) the initial and advanced training locations for the task (3) the existing and projected new frequency for the task (this information is only listed for tasks which require a change in task frequency) (4) the subsystem associated with the task, (5) the design change number associated with the task (this information is only listed for conceptual system task modifications), and (6) the number of the task characteristic worksheet(s) associated with the tasks. The task characteristic worksheets are used to provide more detailed descriptions of the tasks requiring major task modifications (i.e., the MAJ tasks) and the tasks with significant changes in task frequency (i.e., REL tasks which have different existing and projected task frequencies)[1].

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[1] It is possible for a task to be marked REL and still have no difference between the listed, existing, and new task frequency. This reflects the fact that the frequency scale provides only gross classifications and does not capture small changes in task frequency.

Task characteristic worksheets related to reference task modifications are coded with an XXX-R-XX number. Task characteristic worksheets related to conceptual task modifications are coded with an XXX-C-XX number.

C2.2 Task Addition Worksheets

Tables C2-7 to C2-11 display the task addition worksheets which were used to describe the additional tasks, not currently being performed by Army personnel, which will be required for the ESPAWS reference and conceptual systems. The sheets list the projected additional tasks required for the ESPAWS reference/conceptual systems and the comparable task from which the projected task was based. In addition, the following information is listed for each additional task and its associated comparable task: (1) task number (2) initial skill level performing the task (3) initial and advanced training locations and (4) related task characteristic numbers[2].

All of the additional tasks have associated task characterist worksheets which provide more detailed information on the characteristics (e.g., skills and knowledges associated with the task. Since all of the additional tasks are utilized in the reference system, each additional task has a reference task characteristic

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[2] For comparable tasks, the task number is taken directly from the commander's manual. For added tasks the first six digits are taken directly from the comparable task. These digits indicate the career field and location associated with the task. The next digit is identical to the skill level assigned to perform the task. The last three digits are used to distinguish the individual task from one another.

worksheet (marked by XXX-R-XX). In addition, those tasks which are associated with conceptual design changes also have a related conceptual task characteristic worksheet (marked by XXX-C-XX)[3].

[3] The only type of task modification associated with the conceptual system were changes in task frequency (that is REL type task modifications).

Table C2-7. Task Addition Worksheet.

MOS 13B

Component LAND NAVIGATION SYSTEM/ ESPAWS FIRE CONTROL COMPUTER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task	(061-270-1X08)	Perform Operational Check of Land Navigation System	1	Q = AIT A = ANCOC, SELF, SCH	13B-R-18
(Comp Task)	(061-281-1000) (Note 13E Task)	Prepare FADAC for Operation	1	Q = SOJT A = ANCOC, SELF, SCH	
Task	(061-270-1X09)	Operate Land Navigation System	1	Q = AIT A = ANCOC, SELF, SCH	13B-R-19
(Comp Task)	(061-281-1001) (Note 13E Task)	Enter Known Data into FADAC	1	Q = SOJT A = ANCOC, SELF, SCH	
Task	(061-270-1X10)	Operate ESPAWS Fire Control Computer	1	Q = AIT A = ANCOC, SELF, SCH	13B-R-20
(Comp Task)	(061-281-1001) (Note 13E Task)	Enter Known Data into FADAC	1	Q = SOJT A = ANCOC, SELF, SCH	
Task	(061-270-1X11)	Prepare ESPAWS Fire Control Computer for Operation	1	Q = AIT A = ANCOC, SELF, SCH	13B-R-21
(Comp Task)	(061-281-1000) (Note 13E Task)	Prepare FADAC for Operation	1	Q = SOJT A = ANCOC, SELF, SCH	
Task					
(Comp Task)					

Table C2-8. Task Addition Worksheet

MOS 31V-1 Component ESPAWS LAND NAVIGATION SYSTEM (LNS)

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task	113-80X-1X01	Test LNS Equipment Interface and Signal Flow	1	Q - 31VXZ A = SOJT, SELF, TCC	31V-R-1
(Comp Task)	(113-574-2058)	Operate Radio Test Set to Test Modules in AN/URC-12 to a Defective Component, Cable or Accessory	1	Q - AIT A = SOJT, SELF, TCC	
Task	113-80X-1X02	Test Attitude Control Loop/Outputs	1	Q = 31VXZ A = SOJT, SELF, TCC	31V-R-2
(Comp Task)	(113-574-2058)	(As Above)	1	Q - AIT A = SOJT, SELF, TCC	
Task	113-80X-1X03	Test LNS Modes/Operation and Outputs	1	Q = 31VXZ A = SOJT, SELF, TCC	31V-R-3
(Comp Task)	(113-574-2058)	(As Above)	1	Q = AIT A = SOJT, SELF, TCC	
Task	113-80X-1X04	Calibrate LNS Compass	1	Q = 31VXZ A - SOJT, SELF, TCC	31V-R-4
(Comp Task)	(113-574-3036)	Evaluate Operation of Radio Set MN/VRC-46	1	Q = 31VXZ A - SOJT, SELF, TCC	
Task	113-80X-1X05	Troubleshoot LNS and System Displays	1	Q - 31VXZ A - SOJT, SELF, TCC	31V-R-5
(Comp Task)	(113-609-0099)	Systems Troubleshoot COMSEC Security Equipment TSEC/KY-57 with an AN/VRC-12 or AN/VRC-47 Radio	1	Q - AIT A - SOJT, SELF, TCC	

Table C2-8. Task Addition Worksheet (continued)

MOS 31V-1 Component ESPAWS LAND NAVIGATION SYSTEM (LNS)

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task (Comp Task)	113-80X-1X06	Remove and Replace LNS	1	Q = 31VX2 A = SOJT, SELF, SCH	31V-R-6
	113-609-1034	Install COMSEC Equipment TSEC/KY-57	1	Q = AIT A = SOJT, SELF, SCH	
Task (Comp Task)	113-80X-1X107	Inspect LNS		Q = 31VX2 A = SOJT, SELF, SCH	31V-R-7
	(113-587-3028)	Evalute the Operation of UF Radio Set AN/VRC-12		Q = AIT A = SOJT, SELF, SCH	
Task (Comp Task)					
Task (Comp Task)					
Task (Comp Task)					

Table C2-9. Task Addition Worksheet

MOS 31V-2 Component ESPAWS FIRE CONTROL COMPUTER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task	113-70X-1X08	Evaluate the Operation of the ESPAWS Computer	1	Q = 101ASIX1 A = SOJT, SELF, SCH	31V-R-8
(Comp Task)	(091-34G-1440) (Note 34G Task)	Test M18 Gun Direction Computer Using Test Tape B	1	Q = AIT A = SOJT, SELF, TCC	
Task	113-70X-1X09	Remove and Replace Communication Data Link of ESPAWS Computer	1	Q = 101ASIX1 A = SOJT, SELF, TCC	31V-R-9
(Comp Task)	(113-609-1034)	Install COMSEC Equipment TSEC/KY-57	1	Q = AIT A = SOJT, SELF, TCC	
Task	113-70X-1X10	Remove and Replace Wind Velocimeter and Other Sensors Associated with ESPAWS Computer	1	Q = ASIX1 A = SOJT, SELF, TCC	31V-R-10
(Comp Task)	(113-609-1034)	Install COMSEC Equipment TSEC/KY-57	1		
Task	113-70X-1X11	Remove and Replace ESPAWS Computer	1	Q = ASIX1 A = SELF, SOJT, SCH	31V-R-11
(Comp Task)	133-609-1034	Install COMSEC Equipment TSEC/KY-57	1	Q = AIT A = SELF, SOJT, SCH	
Task	(113-70X-1X12)	Repair ESPAWS Computer Terminals and Displays	1	Q = ASIX1 A = SELF, SOJT, SCH	31V-R-12
(Comp Task)	(113-594-0011)	Repair Switchboard Telephone Manual SB22/PT	1	Q = AIT/OSUT A = SOJT, SELF, TCC	

Table C2-9. Task Addition Worksheet (continued)

MOS 31V-2 Component ESPAWS FIRE CONTROL COMPUTER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task (Comp Task)	(113-70X-1X13)	Isolate Faulty Module of ESPAWS Computer Using Built-in Fault Isolation Subroutine	1	Q = ASIXI A = SELF, SOJT, SCH	31V-R-13
	(091-34G-1440) (Note 34G Task)	Test M18 Gun Direction Computer Using Test Tape B	1	Q = AIT A = SOJT, SELF, TCC	
Task (Comp Task)					
Task (Comp Task)					
Task (Comp Task)					
Task (Comp Task)					

Table C2-10. Task Addition Worksheet

MOS 45D (13BU6) Component ESPAWS AUTOLOADER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task	061-272-1X01	Adjust ESPAWS Autoloader	1	Q = 643-45D10 (MOD) A = BNCOC, SELF, SCH	45D-R-1
(Comp Task)	(061-270-3429)	Adjust the Equilibrator on the M109/M109A1	1	Q = SOJT A = BNCOC, SELF, SCH	
Task	061-272-1X02	Repair Hydraulic Components of the MK XXX Autoloader	1	Q = 643-4510 (MOD) A = SOJT, SELF, SCH	45D-R-2
(Comp Task)	(061-270-1473)	Repair Hydraulic Tubes and Fittings to Elevation and Equilibrator Systems (M109/M109A1)	1	Q = 13BU6 A = SOJT, SELF, SCH	
Task	061-272-1X03	Repair Electrical and Electronic Components of the ESPAWS Autoloader	1	Q = 643-45D10 (MOD) A = SOJT, SELF, SCH	45D-R-3
(Comp Task)	(061-270-1466)	Repair Components of the M109/M109A1 Howitzer Cab Electrical System	1	Q = 13BU6 A = SOJT, SELF, SCH	
Task	061-272-1X04	Adjust/Align Autoloader Loader Drum Clutch and Index Rack	1	Q = 643-4510 (MOD) A = SOJT, SELF, SCH	45D-R-4
(Comp Task)	(061-270-1465)	Bleed and Charge Elevating/ Equilibrating Mechanisms of M109/M109A1	1	Q = 13BU6 A = SOJT, SELF, SCH	
Task	061-272-1X05	Adjust Upper Hoist Shutters and Carrier Ejectors for Proper Action	1	Q = 643-45D10 A = SOJT, SELF, SCH	45D-R-5
(Comp Task)	(061-270-1462)	Adjust Rammer Control Assembly on M107	1	Q 13BU6 A = SOJT, SELF, SCH	

Table C2-10. Task Addition Worksheet (continued)

MOS 45D (13B06) Component ESPAWS AUTOLOADER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task (Comp Task)	061-272-1X06 061-272-1466	Inspect Autoloader BITE Components Repair Components of M109/ M109A1 Howitzer Lab Electrical System		Q = 643-4510 (MOD) A = SOJT, SELF, SCH Q = 13B06 A = SOJT, SELF, SCH	45D-R-6
Task (Comp Task)					
Task (Comp Task)					
Task (Comp Task)					
Task (Comp Task)					

Table C2-11. Task Addition Worksheet

MOS 45LX1 Component ESPAWS AUTOLOADER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task	091-452-7X01	Operate the ESPAWS Autoloader in Load Mode	1	Q = 642 AST X1 A = SOJT, SELF, SCH	45L-R-1
(Comp Task)	N/A	Operate Gun Mount 5"/54 MK 42 MOD 98 10 Gun Loading System in Load Mode	2	Q = MK 42 Gunners Mate School A-113-0044	
Task	091-45L-1X02	Perform Preventive Maintenance on the MK XXX Hoist, Cradel, Transfer Trays, Rammer, and Slide	1	Q = 642 AST X1 A = SOJT, SELF, SCH	45L-R-2
(Comp Task)	N/A	Perform Planned Maintenance on the 5"/54 MK42 MOD10 upper gun loading system	2	Q = MK 42 Gunners Mate School A-113-0044	
Task	091-45L-1X03	Isolate and Correct Faults in the MK XXX Loader Drums	1	Q = 642 ASIX1 A = SOJT, SELF, SCH	45L-R-3
(Comp Task)	N/A	Troubleshoot the 5"/54 MK 42 MOD 10 Loader Drums	2	Q = MK 42 Gunners Mate School A-113-0044	
Task	091-45L-1X04	Isolate and Correct Faults in the Hoist of the MK XXX Autoloader	1	Q = 642 ASIX1 A = SOJT, SELF, SCH	45L-R-4
(Comp Task)	N/A	Troubleshoot the 5"/54 MOD 10 Upper Hoist MK 2	2	Q = MK 42 Gunners Mate School A-113-0044	
Task	091-45L-1X05	Isolate and Correct Faults in the MK XXX Autoloader Cradles	1	Q = 642 ASIX1 A = SOJT, SELF, SCH	45L-R-5
(Comp Task)	N/A	Troubleshoot the 5"/54 MK 42 MOD 10 Cradles	2	Q = MK 42 Gunners Mate School A-113-0044	

Table C2-11. Task Addition Worksheet (continued)

MOS 45LX1 Component ESPAWS AUTOLOADER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
Task	091-45L-1X06	Isolate and Correct Faults in the MK XXX Autoloader Transfer Trays	1	Q - 642 ASIXI A - SOJT, SELF, SCH	45L-R-6
(Comp Task)	N/A	Troubleshoot the 5"/54 MK 42 MOD 10 Transfer Trays	2	Q - MK 42 Gunners Mate School A-113-0044	
Task	091-45L-1X07	Isolate and Correct Faults in the MK XXX Autoloader Rammer	1	Q - 642 ASIXI A - SOJT, SELF, SCH	45L-R-7
(Comp Task)	N/A	Troubleshoot the 5"/54 MK 42 MOD 10 Rammer MK 2 MOD 3	2	Q - MK 42 Gunners Mate School A-113-0044	
Task	091-45L-1X08	Isolate and Correct Faults in the MK XXX Autoloader Slide	1	Q - 642 ASIXI A - SOJT, SELF, SCH	45L-R-8
(Comp Task)	N/A	Troubleshoot the 5"/54 MK 42 MOD 10 Slide MK 31 MOD 3	2	Q - MK 42 Gunners Mate School A-113-0044	
Task	091-45L-1X09	Test the Operation of the Hall Effect Proximity Switches Used in the ESPAWS Autoloader.	1	Q - 642 ASIXI A - SOJT, SELF, SCH	45L-R-9 45L-C-1
(Comp Task)	091-45L-1401	Perform a Continuity Test of an Electrical Circuit Using a Multimeter	1	Q - AIT A - SOJT, SELF, SCH	
Task	091-45L-1X010	Test the Operation of the Latching Relay Circuit, Logic Circuit, and Solenoid Driver Circuit Cards with the Circuit Card Tester TS XX3	1 *	Q - 642 ASIXI A - SOJT, SELF, SCH	45L-R-10 45L-C-2
(Comp Task) *					

*Continued on next page.

Table C2-11. Task Addition Worksheet (continued)

MOS 45LX1 Component ESPAWS AUTOLOADER

	Task Number	Task Description	Skill Level	Training Setting	Related Task Characteristic Worksheet
(Comp Task)	091-45L-3411	Use Electric Drive Control Test Set to Isolate Malfunctioning Components of Current Electrical System of AR/AAU 551	3	Q - PLC PTT A - SOJT, SELF, SCH	
Task (Comp Task)					
Task (Comp Task)					
Task (Comp Task)					
Task (Comp Task)					

APPENDIX C3
TASK CHARACTERISTIC WORKSHEETS

This appendix describes the task characteristic worksheets that were used to describe the characteristics of the modified and additional tasks identified in the task modification/addition worksheets listed in Appendix C2.

The appendix is divided into two sections. The first section describes the task characteristic worksheets which were used with tasks which only required a change in task frequency. The second section describes the task characteristic worksheets which were used with tasks requiring major modification or where new tasks were developed specifically for ESPAWS.

C3.1 Task Characteristic Worksheets A

A separate set of worksheets (task characteristic worksheets A were used to describe the characteristics of the tasks which only required a change in task frequency (the tasks identified by the code "REL" in the task description worksheets in Appendix C2). Since only the frequency with which these tasks are performed changes, and not any other essential features of the task, a detailed description of the skills and knowledges of these tasks is not required. Hence, these tasks do not require the detailed description that the other modified and additional tasks require.

Table C3-1 lists the task characteristic worksheets which were developed for the ESPAWS REL tasks. Each one of these worksheets lists all of the reference or conceptual tasks

Table C3 1 Task Characteristic Worksheets - A

Task Characteristic Worksheet No 13B R-2

Task Type REL System Associated with REF MOS 13R

Task Number	Task	Exist. Freq.	New Freq.	Difficulty	Importance	Initial Training Location		Advanced Training Location	
						Exist	New	Exist	New
061 266 1101	Emplace/recover collimator	4	3	NOT	YES	AIT/OSUT	AIT/OSUT	SOJT,SELF ,SCH	SOJT,SELF ,SCH
061 266 1103	Emplace/recover aiming posts	4	3	NOT	YES	AIT/OSUT	AIT/OSUT	SOJT,SELF ,SCH	SOJT,SELF ,SCH
061 266 1215	Set/lay the cannon for quadrant with the range quadrant	4	3	MOD	YES	SOJT	SOJT	BNCOC, ANCOC SELF,	BNCOC, ANCOC SELF,
061 266 1216	Measure the quadrant with range quadrant	4	3	MOD	YES	SOJT	SOJT	BNCOC, ANCOC SELF, SCH	BNCOC, ANCOC SELF, SCH
061 266 2168	Fire the cannon (manual)	4	3	MOD	YES	AIT/OSUT	SOJT*	SOJT, SELF SCH	SELF, SCH
061 266 1219	Clean the powder chamber after firing	4	3	NOT	YES	AIT/OSUT	SOJT*	SOJT, SELF SCH	SELF, SCH
061 266 1401	Inspect and clean the collimator	4	3	NOT	YES	AIT/OSUT	AIT/OSUT	SOJT, SELF SCH	SOJT, SELF SCH
061 266 1402	Inspect and clean aiming posts and night lighting devices	4	3	NOT	YES	AIT/OSUT	AIT/OSUT	SELF, SCH	SELF, SCH
061 270 1514	Load a prepared round for firing in M109/M109 A1 (manual)	4	3	MOD	YES	AIT/OSUT	SOJT*	SOJT, SELF, SCH	SELF, SCH
061 266 1452	Purge and charge fire control equip.	4	4	VERY	YES	13BU6	SOJT*	SOJT, SELF, SCH	SELF, SCH
061 266 2221	Lay the cannon for initial direction of fire	4	3	VERY	YES	SOJT	SOJT	ANCOC, SELF, SCH	ANCOC, SELF, SCH
061 266 2223	Align collimator/aiming posts	4	3	VERY	YES	SOJT	SOJT	ANCOC, SELF, SCH	ANCOC, SELF, SCH
061 266 2229	Set/lay the cannon for deflection (manual)	4	3	VERY	YES	SOJT	SOJT	ANCOC, SELF, SCH	ANCOC, SELF, SCH
061 266 2231	Refer the piece	4	3	MOD	YES	SOJT	SOJT	ANCOC, SELF, SCH	ANCOC, SELF, SCH
061 270 2225	Boresight the panoramic telescope using distant aiming point	4	3	VERY	YES	SOJT	SOJT	SELF, SCH	SELF, SCH
061 270 2228	Boresight the panoramic telescope using testing target	4	3	VERY	YES	SOJT	SOJT	SELF, SCH	SELF, SCH
061 266 3304	Verify emplacement of aiming points and recording of deflections	4	3	MOD	YES	BNCOC	BNCOC	ANCOC, SOJT, SELF, SCH	ANCOC, SOJT, SELF, SCH
061 266 3110	Perform gunner's micrometer test	4	3	VERY	YES	BNCOC	BNCOC	ANCOC, SOJT, SELF, SCH	ANCOC, SOJT, SELF, SCH
061 266 3110	Perform gunner's quadrant end to end test	4	3	VERY	YES	BNCOC	BNCOC	ANCOC, SOJT, SELF, SCH	ANCOC, SOJT, SELF, SCH
061 266 3318	Set/lay for quadrant with gunner's quadrant	4	3	VERY	YES	BNCOC	BNCOC	ANCOC, SOJT, SELF, SCH	ANCOC, SOJT, SELF, SCH
061 266 3319	Measure the quadrant with gunner's quadrant	4	3	VERY	YES	BNCOC	BNCOC	ANCOC, SOJT, SELF, SCH	ANCOC, SOJT, SELF, SCH
061 270 3307	Perform fire control alignment tests on M109/M109 A1	4	3	VERY	YES	SOJT	SOJT	BNCOC, SELF, SCH	BNCOC, SELF, SCH

*New training assignments different from previous assignment

Table C3.1 Task Characteristic Worksheets - A (continued)

Task Characteristic Worksheet No 13B

Task Type REL System Associated with CONCEPTUAL MOS 133

Task Number	Task	Exist Freq	New Freq.	Difficulty	Importance	Initial Training Location		Advanced Training Location	
						Exist	New	Exist	New
061 270 1468	Replace solenoid or combined solenoid and rammer control valve	3	2	MOD	YES	13BU6	45D10	SOJT, SELF, SCH	SOJT, SELF, SCH
061 270 1474	Repair cab/turret wiring harness	3	2	MOD	YES	13BU6	45D10	SOJT, SELF, SCH	SOJT, SELF, SCH

*New training assignments different from previous assignment

Table C3 1 Task Characteristic Worksheets – A (continued)

Task Characteristic Worksheet No 41C-C-1

Task Type REL System Associated with CONCEPTUAL MOS 41C

Task Number	Task	Exist Freq.	New Freq.	Diffi-culty	Import ance	Initial Training Location		Advanced Training Location	
						Exist	New	Exist	New
091 41C 1401	Perform torque inspection of collimator M1	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 1403	Charge infinity collimator M1 with nitrogen	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 2404	Replace rheostat in remote control light source of collimator	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 1445	Repair aiming posts	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 1571	Troubleshoot cross-level mechanism in fire control quadrant	4	3	VERY	YES	AIT	AIT	FOJT	FOJT
091 41C 2572	Replace bent wormshaft in fire control quadrant M15	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 1580	Troubleshoot panoramic telescope	4	3	VERY	YES	AIT	AIT	FOJT	FOJT
091 41C 1581	Charge panoramic telescope M115 with nitrogen	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 1582	Replace cracked lens in eye piece of panoramic telescope	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 1600	Install telescope mount M145 in M109	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
091 41C 1601	Synchronize telescope mount M145 in M109	4	3	MOD	YES	AIT	AIT	FOJT	FOJT

*New training assignments different from previous assignment

Table C3-1 Task Characteristic Worksheets – A (continued)

Task Characteristic Worksheet No 45L C-1

Task Type REL System Associated with CONCEPTUAL MOS 45C

Task Number	Task	Exist. Freq.	New Freq	Diffi-culty	Import-ance	Initial Training Location		Advanced Training Location	
						Exist	New	Exist	New
091-45L-1X09	Operate the Hall Effect proximity switches in ESPAWS autoloader	4	3	MOD	YES	(NAVY)	642ASIX1	(NAVY)	SOJT, SELF, SCH
091-45L-1X10	Test operation of latching relay circuit, and solenoid driver circuit cards	4	3	MOD	YES	(NAVY)	642ASIX1	(NAVY)	SOJT, SELF, SCH

*New training assignments different from previous assignment

Table C3 1 Task Characteristic Worksheets -- A (concluded)

Task Characteristic Worksheet No 63C-C-1

Task Type REL System Associated with CONCEPTUAL MOS 63C

Task Number	Task	Exist. Freq.	New Freq.	Diffi-culty	Import-ance	Initial Training Location		Advanced Training Location	
						Exist	New	Exist	New
041 63C 1685	Remove an M109 howitzer power plant	4	3	VERY	YES	AIT	AIT	FOJT	FOJT
041 63C 1712	Remove and replace coolant radiator on M109 A1 howitzer	4	3	MOD	YES	AIT	AIT	FOJT	FOJT
041 63C 1698	Remove and replace air cleaners on M109 A1 howitzer	5	4	MOD	YES	AIT	AIT	FOJT	FOJT
041 63C 1729	Remove and replace starter on an 8V71T engine	4	3	MOD	YES	AIT	AIT	FOJT	FOJT

*New training assignments different from previous assignment

associated with a particular MOS. For each REL task, the following information is listed: (1) task number (2) the existing frequency with which the task is performed, (3) the estimated difficulty of the task (4) the estimated importance of the task, (5) the initial and advanced training locations for the existing task and (6) the initial and advanced training locations for the task with its new frequency.[1]

C3.2 Task Characteristic Worksheets B

Table C3-2 provides an example of the type of detailed worksheets that were used to describe the task characteristics of the additional tasks or the tasks requiring major modification. To save space, only one example of these worksheets is provided. (The number of these worksheets is quite large.) Each worksheet has two pages. The first page lists the modified or additional task being described and the comparable existing task used in deriving this new task. For both the new and comparable task, the following information is listed (1) task number (2) skill level, (3) initial and advanced training locations, (4) associated media, (5) the frequency, difficulty, importance and duration (optional) of the task and (6) special support equipment, tools, etc., associated with the task.[2]

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[1] The term "existing frequency" only refers to the current Army frequency when one is dealing with reference REL tasks, however, for conceptual REL tasks, it refers to the frequency with which the reference tasks were performed. This latter frequency may not be equal to the current task frequency if the frequency of the reference task itself changed.

Table C3-2. Task Characteristic Worksheet B – Example.

Task Characteristic Worksheet No 45L R-4

Task Type REL ____ MOD ____ ADD X

MOS 45L

System Associated with: REF: X Conceptual X

Associated Subsystem ESPAWS Autoloader

Associated Design Change Numbers NA

Task Number	Task	Skill Level	Initial Training Location	Additional Training Location	Associated Media	Frequency	Difficulty	Importance	Duration (Optional)	Associated Support/Test Equip., Tools
091 45L 1X04	Isolate faults in the hoist of the MKxxx Autoloader	1	642 AS1X1	SOJT Self. Sch.	TBD	MOD.	MOD.	Yes	–	Multimeter

COMPARABLE TASK DATA

N/A	Troubleshoot the 5"/54 MK42 MOD 10 Upper hoist MK2	2	Navy Course A-113-0044	OJT		MOD.	MOD.	Yes	–	Multimeter

FREQUENCY ____ DIFFICULTY ____ IMPORTANT ____

Table C3-2 (continued)

Task Characteristic Worksheet B -- Example

SKILLS AND KNOWLEDGES ASSESSMENT

1 Relevant skills and knowledges from comparable task:

1.1 Perform voltage checks with a multimeter

1.2 Perform circuit continuity checks with a multimeter

1.3 Describe Principals of hydraulic operation

1.4 Describe general safety precautions

2 Additional skills and knowledges required:

2.1 Describe mechanical functioning of the hoist

2.2 Describe hydraulic functioning of the hoise

2.3 Describe control circuits functioning of the hoise

2.4 Identify the steps and step sequence for testing the hoise

2.5 Identify correct test results

2.6 Analyze the hoist test results

2.7 Identify hoist information in the MKxxx autoloader reference manuals

2.8 Identify relevant circuit card inputs and outputs

2.9 Identify autoloader hoist specific safety precautions

2.10 Perform parts replacement and removal

Page two of the task characteristics worksheets-B lists the relevant skills and knowledges required by the new task. These skills and knowledges are broken down into categories: (a) those which are equivalent to the skills and knowledges associated with the comparable task and (b) the additional skills and knowledges required by the new task.

[2] The media associated with each task are not listed in the example because the media associated with the modified or additional tasks were not identified in this phase of the ESPAWS study.

APPENDIX C4
COURSE MODIFICATION/DEVELOPMENT WORKSHEETS

This appendix describes the worksheets that were used in modifying existing courses and developing new courses. The appendix is divided into two sections. The first section describes the worksheets used in modifying existing courses while the second section describes the worksheets used in developing new courses.

C4.1 Course Modification Worksheets

Three courses were modified for the ESPAWS reference/conceptual systems: Field Artillery Crewman Course (041-13B10); the FADAC Course (101-ASIF7) which was modified to develop the ESPAWS computer course (101-ASIX1); and the Field Artillery Turret Mechanic Course (643-45D10). The modified course developed for the reference system were again used in the conceptual system without further modification because no significant difference between the reference and conceptual system tasks was projected. Tables C4-1, C4-2, and C4-3 list the course modification worksheets for each of the three modified courses.

Each of the course modification sheets lists all of the course modules/elements from the existing course and the additional course modules/elements required to meet the task, skill, and knowledge requirements of the equipments associated with the projected course. For each course element, the following information is listed (1) hours of instruction for the course element in the projected course, (2) hours of instruction for the course element in the

Table C4 1 Course Modification Worksheet

Reference, Conceptual

Course 041-13B10 MOS 13B

Projected Course/Elements	Hours	Type of Instruction	Current Hours	Current Types of Instruction	Module(s)/Courses Used to Project Added Modules	Related Tasks
School of Soldier	78	-	78			
Weapons Training	65		65	--		
Combat Skills and Tech	117	-	117	-		
Artillery Common	70		70	-		
Self Propelled Track	-	.	.	--		
o Intro to Self Prop	(1)	1C	(1)	1C		
o Prepare Cannon Ammunition for Firing*	(2)	2PE1	(2)	2PE1	Prepare cannon ammunition for firing	061 266 1506 (MOD),061 266 1604/(ADD)
o Introduction to PM/LO	(2)	.25C, 1.75PE1	(2)	.25C, 1.75PE1		
o Operation of Power/Rammer Breech*	0	-	(2)	2.0 PE1		
o Operation/Function of Autoloader*	(2)	2.0PE1	0	0	Operation/Function of Autoloader	061 270 1514 (MOD), 061 266 1218 (MOD) 061 266 1218 Manual (DEL)
o Fire Control Equip	(2)	2.0PE1	(2)	2.0PE1		
o Muzzle Break and Chamber	(2.5)	2.5PE1	(2.5)	2.5PE1		
o Duties of Cannoneer*	(3.0)	3.0PE1	(4)	4.0PE1		061 270 1514 (MOD), 061 266 1219 (DEL) 061 270 1514 Manual (DEL)
o Intro to 50 CAL MG	(2.0)	2.0PE1	(2.0)	2.0PE1		
o FAM Firing 50 CAL	(6.0)	6.0PE1	(6.0)	6.0PE1		
o Safety Procedures	(1.0)	1.0C	(1.0)	1.0C		
o RSOP*	(9)	9.0C	(11)	11.0C		061 266 1101(MOD),061 266 1701(MOD) 061 266 1702(MOD)
o Maintenance*	(22)	22PE1	(20)	20PE1		016 270 1X08(ADD),061 270 1X11 (ADD)
o Operation of Land Navigation System and Fire Control Comp*	(3)	3PE1	(0)	-		081 270 1X09(ADD),061 270 1X11 (ADD)
o M110	(57)	9.3C, 47.7PE1	(57)	9.3C, 47.7PE1		
Exam	(3.5)	3.5E1	(3)	3.0E1		
Subtotal (SP Track)	78.5		78	-		
Nonacademic	51		51.0			
Total	500.0		497.5			
Training Time (week)	12.5 weeks		12.4 weeks			
		Instructional Breakdown C/E3 - 50.75 PE1 - 398.25		Instructional Breakdown C/E3 - 50.25 PE1 - 396.25		

Table C4.2 Course Modification Worksheet

Reference, Conceptual

Course 101 ASIX1 MOS 31V

Projected Course Elements	Hours	Type of Instruction	Current Hours	Current Types of Instruction	Module(s)/Courses Used to Project Added Modules	Related Tasks
CR27UW Introduction to digital computers	1.7	1.4D, .3F	1.7	1.4D, .3F	Introduction to digital computers	113 70X 1X08 113 70X 1X11 net 113 70X 1X12
CR27AC Introduction to M18 Gun* Direction Computer Maintenance	0		8.4	1C, 2.4TV, 5PE1		Delete
Introduction to ESPAWS Computer Field Maintenance*	8.4	1C, 2.4TV 5PE1	8.4	1C, 2.4TV, 5PE1	CR27AC Introduction to M18 Gun Direction Computer Maintenance	113 70X 1X09 113 70X 1X10 113 70X 1X11
CR27AQ M18 Computer Power* Control Circuits	0		5	9C, 4.1PE1		Delete
Repair of Communications* Data Link to ESPAWS Computer	10	1.8C, 8.2PE1	5	9C, 4.1PE1	CR27AQ M18 Computer Power Control Circuits	113 70X 1X09 113 70X 1X10 add +5 hrs
CR27AU Operational Check of M18 Computer*	0		7.5	8C, 6.7PE1		
Proper removal and replacement* procedures of an ESPAWS Computer	7.5	8C, 6.7PE1	7.5	8C, 6.7PE1	CR27AU Operational Check of M18 Computer	113 70X 1X11
CR27AO Diagnostic Logic Troubleshooting	9	9D	9	9D	CR27AO Diagnostic Logic Troubleshooting	113 70X 1X12 Net
CR27AO ESPAWS Computer Troubleshooting*	22.9	9D, 22PE1	22.9	9D, 22PE1	CR27AS M18 Computer Troubleshooting	113 70X 1X13 Net
CR2702 Examination	7.5	7.5E1	7.5	7.5E1	CR2702 Examination	Examination
Sub Annex A2 M16 Radar Chronograph Maintenance	0					
Total Academic	58.9		95.4			
Inprocessing	8.0		8.0			
Outprocessing	8.0		8.0			
Commandant's Time	6		6			
Total Nonacademic Time	16.6		16.6			
Total	75.5		112			
Training Time 14 Weeks	1.89 weeks		2.8 weeks			
		Instructional Breakdown PE1 - 41.9 TV - 2.4 D - 3.2 C - 3.6 F - .3 E1 - 7.5		Instructional Breakdown PE1 - 57.8 TV - 2.6 D - 5.4 C - 7.7 F - .3 E1 - 19.2 PI - 2.4		

Table C4 3 Course Modification Worksheet

Reference, Conceptual

Course 643 45D10 MOS 46D (13B46)

Projected Course/Elements	Hours	Type of Instruction	Current Hours	Current Types of Instruction	Module(s)/Courses Used to Project Added Modules	Related Tasks
Organizational Maintenance	23	8 1C, 1.4TV, 1 5PE1, 7 6PE3, 1 0PE2, 1.00D, 2E1, .4TF	23	8 1C, 1 4TV, 1.5PE1, 7 6PE3, 1.0PE2, 2 0E1, 4TF		
M110 Series Howitzer	29	3.2C, 20.4PE1, 2 0PE3, 3E1 4TV	29	3 2C, 20.4PE1, 2 0PE3, 3F1, .4TV		
Miscellaneous Subjects	13	2.5C, 10PE1 5TF	13	2 5C, 10PE1, 5TF		
ESPAWS Howitzer						
o Perform Main of Breech Mech	(6)	6C, 5.2PE1, .2PE3	(6)	6C, 5.2PE1, 2PE3		
o Remove/Install Breech Block	(6)	5C, 5 3PE1, 2PE3	(6)	5C, 5 3PE1, .2PE3		
o Adjust Operating CAM	(4)	4C, 3.4PE1, .2PE3	(4)	4C, 3 4PE1, 2PE3		
o Pure Fire Control Inst *	(1)	1.0C	(5)	5C, 4 2PE1, 3PE3	Perform Fire Control (M109) 643 4510	061 266 1457(DEL)
o Remove/Install Tel Mount (M145)	(6)	5C, 5 2PE1, 3PE3	(6)	6C, 5 2PE1, .3PE3		
o Adjust Telescopic Mount	(10)	1.5C, .4TV, 7 8PE1, .3PE3	(10)	1 5C, 4TV, 7 8PE1, .3PE3		
o Replace Hydraulic Components*	(10)	1.3C, 8 2PE1, 5PE3	(4)	5C, 3.3PE1, .2PE3	Replace Hydraulic Comp (M109) 643 4510	061 272 1X02(ADD)
o Perform Slip Ring Contact Maint	(10)	1.5C, 4TV, 7 8PE1, 3PE3	(10)	1 5C, 4TV, 7 8PE1, 3PE3		
o Troubleshoot Elect Systems*	(20)	1 9C, 17 6PE1, .5PE3	(16)	1 5C, 14 1PE1, 4PE3	Troubleshoot Elec. Systems (M109) 643 4510	061 270 1468(MOD), 061 272 1X03(ADD)
o Repair Autoloader*	(8)	8C, 6 7PE1, 5PE3	--	-	Replace Rammer Trav. Mech (M110)643 4510	061 270 3436(MOD),061 272 1X01(ADD)
o Exam*	(11)	11E1	(9)	9E1		061 272 1X04(ADD),061 272 1X05(ADD) 061 272 1X06(ADD)
Subtotal (M109)	92		76			
End of Course Exam*	17 0	17 0E1	16	16E1		
Total Academic	174		157			
In/Output Processing	8		8			
Physical Cond	12		12			
Open Time	8		8			
Commandant s Time	9		9			
Total Nonacademic	36	36				
Total	210		192			
Training Time Weeks	5 2 wks		4 8 wks			
		Instruction Time Breakout C 23 8 D 1 0 F 9 PE1 89 5 PE2 1 0 PE3 12 2 E1 33 0		Instruction Time Breakout C 21 3 D 1 0 F 9 TV 2 6 PE1 88 6 PE2 1 0 PE3 11 6 E1 30 0		

projected course broken down by instructional method, (3) hours of instruction for the course element in the existing course, and (4) hours of instruction for the course element in the existing course broken down by instructional method. In addition, for all modified, or additional course elements (identified by stars in the table), the sheets list the existing modules used to develop these modules, the courses associated with these existing modules, and the reference/conceptual tasks related to these modules.

At the bottom of each sheet, total academic hours, nonacademic hours, and total training time both in hours and weeks, are listed along with a breakdown of the total academic hours by instructional method for both the existing and projected course.

C4.2 Course Development Sheets

Two completely new courses were developed for the ESPAWS reference/conceptual system: ESPAWS Land Navigation Computer Maintenance Course (101-ASIX2) and the ESPAWS Autoloader Maintenance Course (642-ASIX1) As with the modified courses, the new courses developed for the reference system were used again in the conceptual system without modification. Tables C4-4 and C4-5 list the course development worksheets for each of the two new courses.

The course development worksheets list the course elements/modules projected for the new courses. Along with the following information associated with each course module: (1) The total instructional hours for each module, (2) the instructional hours for each element broken down by instructional method, (3) the student instructor ratio

Table C4.4. Course Development Worksheet

Course 642 ASIX1 ESPAWS Autoloader

MOS 45LX1 Reference X Conceptual X

Course Module	Hours	Type Instruction	S/I Ratio	Relevant Modules from Existing Course: Module	Hours	Type Inst	S/I Ratio	Course	Related Task Numbers
1 Identify Autoloader Components	1.7	5C 1.2D	1.20 1.20	MK42 MOD941G Gunner's Mate School Operate Gun Mount 5"/54 MK42 Mod 9 & 10	NA	NA	NA		091 45L 1X01,2,3,4,5,6,7,8,9
2 Follow Ammunition Handling, Electrical, Personnel, and Hydraulic Safety Precautions	1.9	1.0C	1.20 1.20	Gun Loading System in Load Mode.				A 113 0044 (Navy Course)	091 45L 1X01,2,3,4,5,6,7,8,9,10
3 Identify the control panel switches and indications and describe their purpose/function	1.4	1.4D	1.20 1.20						091 452 1X01
4 Operate the MKxxx Automatic Loading System	2.8	8D 1PE1 1E1	1.20 1.6 1.6						091 452 1X01
5 Perform Preventive Maintenance									
a Hoist	11.5	2.3PE1	1.6	MK42 MOD9&10 Gunner's Mate School	NA	NA	NA	A 113 0044	091 452 1X02
b Cradel		2.3PE1	1.6	Perform planned maintenance on gun mount 5"/54					
c Transfer trays		2.3PE1	1.6	MOD9&10					
d Hammer		2.3PE1	1.6						
e Slide		2.3PE1	1.6						
6 Test the operation of the Hall Effect proximity switches used in the MKxxx control circuits	2.3	4C 1PE1 9E1	1.20 1.6 1.6	MK42 MOD9&10 Gunner's Mate School Describe the operation of the Hall Effect proximity switches	NA	NA	NA	A 113 0044	091 45L 1X010
7 Test the operation of the latching relay circuit, logic circuit and driver circuit cards with the circuit card tester TSxxx	3.4	5D 2PE1 9E1	1.20 1.6 1.6	09 45L 3412 Use electric drive control test set to isolate malfunctioning components of turret electrical system of AR/AAU051	NA	NA	NA	A 113 0044	091 45L 1X011
8 Isolate faults in the automatic loader MKxxx Loader Drums	2.7	25PE1 2E1	1.6 1.6	MK42 MOD9&10 Gunner's Mate School Troubleshoot the 5"/54 MK42 MOD10 loader drums	NA	NA	NA	A 113 0044	091 45L 1X03
a Identify and correct mechanical faults in the loader drum components	1.67	4C (2) 2E1	1.20 1.20						
b Identify and correct faults in the MKxxx loader drum hydraulic circuits	3.1	1C 2.1PE1	1.20 1.6						
c Identify and correct faults in the electrical control circuits	4.1	1C 3.1PE1	1.20 1.6						
9 Isolate faults in the MKxxx Hoist	7.03	2.5PE1 2E1	1.6 1.6	Troubleshoot the 5"/54 MK MOD10 upper hoist MK2	NA	NA	NA	A 113 0044	091 45L 1X04
a Identify and correct faults in the hoist		1C 1.53PE1	1.20 1.6						
b Identify and correct faults in the MKxxx hoist electrical control circuits	2.53	1C 1.53PE1	1.20 1.6						
c Identify and correct faults in the MKxx hoist hydraulic functions	2.83	83C 20PE1	1.20 1.6						

Table C4-4. Course Development Worksheet.

Course 642 ASIX1 FSPAWS Autoloader

MOS 45LX1 Reference X Conceptual X

Course Module	Hours	Type Instruction	S/I Ratio	Relevant Modules from Existing Course: Module	Hours	Type Inst.	S/I Ratio	Course	Related Task Numbers
10 Isolate faults in the automatic loader MKxxx and cradle	4.0	2.5PE1 2E1	1:6 1:6	MK42 MOD9&10 Gunner's Mate School Troubleshoot the 5"/54 MK42 MOD10 cradles	NA	NA	NA	A 113 0044	091 45L 1X06
a. Identify and correct mechanical faults in the loader components	3.0	1.C 1.PE1	1:20 1:6						
b Identify and correct faults in the cradle hydraulic circuits	4.15	.9C 3.25PE1	1:20 1:6						
c Identify and correct faults in the cradle electrical control circuits	3.33	.83C 2.5PE1	1:20 1:6						
11 Isolate faults in the automatic loader MKxxx transfer trays	4.5	2.5PE1 2.0E1	1:6 1:6	MK42 MOD9&10 Gunner's Mate School Troubleshoot the MK42 MOD10 transfer trays	NA	NA	NA	A 113 0044	091 45L 1X06
a. Identify and correct mechanical faults in the transfer tray	3.3	.83C 2.47PE1	1:20 1:6						
b Identify and correct faults in the transfer tray hydraulic circuits	3.34	2.0C 1.34PE1	1:20 1:6						
c Identify and correct faults in the transfer tray electronic control circuits	3.33	.83C 2.5PE1	1:20 1:6						
12 Isolate faults in the automatic loader MKxxx Rammer	4.5	2.5PE1 2.0E1	1:6 1:6	MK42 MOD9&10 Gunner's Mate School. Troubleshoot the 5"/54 MK42 MOD10 rammer MK2 MOD3.	NA	NA	NA	A 113 0044	091 45L 1X07
a Identify and correct faults in the rammer		.85C 2.5PE1	1:20 1:6						
b Identify and correct faults in the rammer hydraulic circuits	3.34	2.0C 1:34PE1	1:20 1:6						
c Identify and correct faults in the rammer electrical control circuits	3.33	.83C 2.5PE1	1:20 1:60						
13 Isolate faults in the MKxx Slide	6.93	2.5PE1 2.0E1	1:6 1:6	MK42 MOD9&10 Gunner's Mate School Troubleshoot the 5"/54 MK42 MOD10 Slide MK31 MOD3	NA	NA	NA	A 113 0044	091 45L 1X08
a Identify and correct mechanical faults in the slide components		.83C 1.6PE1	1:20 1:6						
b Identify and correct faults in the slide hydraulic circuits	1.66	.83C .83PE1	1:20 1:6						
c Identify and correct faults in the slide electronic control circuits	1.66	.83C .83PE1	1:20 1:6						
d Identify the functions of the slide pneumatic circuits	9	5C 4PE1	1:20 1:6						
Academic Total	105								
14 Inprocessing	8								
15 Outprocessing	6								
16 Commander's Time	12.6								
Total Time	133.6								
Training Time in Weeks	3 weeks 2 days								
Instruction Type Breakdown									
C 20.8									
D 3.8									
PE1 66.3									
E1 14.1									

Table C4-6 Course Development Worksheet.

Course _____ Land Navigation System No ASIX2

MOS 31V Reference X Conceptual X

Course Module	Hours	Type Instruction	S/I Ratio	Relevant Modules from Existing Course: Module	Hours	Type Inst.	S/I Ratio	Course	Related Task Numbers
Introduction to the principles of the Land Navigation System	1.0	1C	–	Course Introduction	1.0	1C	–	101 31V1 0	113 80X 1X01 thru 113 80X 1X07
Introduction to the LNSX Test Set	4.5	3.8PE1 .7PE3	1:6 1:20	CR26 HE Evaluate Operation of AN/VRC 12 Radio Set	4.5	3.8PE1 .7PE3	1:6	101-31V10	113 80X-1X01 thru 113 80X-1X06
Test LNS Equipment Signal Flow with the LNSX Test Set	8	2SP 5PE2 1E2	1:20 1:6 1:6	34G10-L-2 Student will trace FADAC wiring	8	2SP 5PE2 1E2	1:20 1:6 1:6	113-34G10	113 80X 1X02
Test LNS Attitude Control Loop/Controls	5.3	4.5PE1 .8PE3	1:6 1:20	CR28HC Troubleshoot AN/VRC-12 Series Radio Power Input Circuit	5.3	4.5PE1 .7PE3	1:6 1:20	101 31V10	113 80X-1X02
Test LNS Operational Modes	10 0	3 0SP 6.0PE2 1.0E2	1:20 1:6 1:6	34G10L4 FADAC Power Supplies, functional diagrams, functions, inputs	10.0	3SP 6PE2 1E2	1:20 1:6 1:6	113 34G10	113 80X 1X03
LNSX Test Set Troubleshooting and Inspection Laboratory	66.0	4.0SP 57.5PE1 4.5E1	1:20 1:6 1:6	34G10K5 FALK Test Set Troubleshooting Laboratory	66.0	4 0SP 57.5PE1 4.5E1	1:20 1:6 1 6	113-34G10	113-80X 1X04 113 80X 1X05 113 80X 1X06 113 80X 1X07
Total Academic	94.8								
Inprocessing	8.0								
Outprocessing	8.0								
Commandant's Time	1.2								
Total Training Time	112.0 2.8 weeks								

Instructional Breakdown

SP	9 0
C	1.0
PE1	65 8
PE2	11 0
PE3	1 5
E1	4 5
E2	2 0

associated with each instructional method, (4) relevant course modules from existing courses used in developing the projected course module, (5) instructional hours for the existing modules broken down by instructional method along with their associated student instructor ratios, where applicable, and (6) the course(s) from which existing module(s) were taken[1].

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[1] Instructional hours and student instructor ratios were not listed for the Navy course modules used in developing the 642-ASIX1 course since the Navy classification scheme for instructional methods is different from that used in the Army. The Navy version of this course uses conference or C1 as the primary type of instruction. DRC has noted a tendency for the Army training to be performance based to a greater extent than comparable Navy courses. Adjustments were made for this tendency in assigning the number of hours for each type of instruction in the 642-ASIX1 course.

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APPENDIX C5
DETERMINATION OF NUMBER OF INSTRUCTORS

Estimation of the number of instructors associated with the system-specific ESPAWS courses was determined by applying a modified version of the instructor determination algorithm listed in the Staffing Guide for U.S. Army Service Schools (DA PAM 570-558). Basically, this algorithm was modified to make total instructor contacts hours a direct function of the number of students taking the course (which is determined by the number of students taking the course and the optimum class size).

C5.1 Instructor Determination Algorithm

The final modified algorithm used to determine ESPAWS instructor requirements was as follows.

$$NINS = \left(\frac{ICH}{OC} \times NREP\right) \div 1250$$

where NINS is the number of instructors required for the course; ICH is the total instructor contact hours associated with the course, OC is the optimum class size for the course, NREP is the number of personnel taking the course and 1250 is the annual amount of instructor contact specified for an instructor in DA PAM 570-558.

Tables C5-1, C5-2, and C5-3 display the input values and calculations associated with the determination of instructors for each of the system-specific courses in the

Table C5-1. Predecessor Instructor Determination Worksheet

MOS	Course Number	Course	(A) Total ICH per Class	(B) Optimum Class Size	(C) ICH Per Student (A – B)	(D) Number of Students	(E) Total ICH (C) x (D)	Number of Instructors (E) – 1250
13B	041-13B10	Field Artillery Crewman	2741.5	40*	68.5	9243	633145.5	506.5
(45D)	643-45D10 (MOD)	Field Artillery Turret Mechanic	479.2*	20*	24	N/A	–	–
31V	101-31V10	Tactical Communications Systems Operator	2166.7	35	61.9	N/A	–	–
41C	670-41C10	Fire Control Instrument Repair	2116.4	14	151.1	39	5892.9	4.7
44B	700-44B10	Metalworker	1326.0	18	73.7	47	3463.9	2.8
45K	643-45K10	Tank Turret Repair	1166.8	18	64.8	333	21578.4	17.3
45L	642-45L10	Artillery Repair	914.3	14	65.3	114	7444.2	6
45L	642-ASIX1	ESPAWS Autoloader	291.5	20*	14.6	NA	–	–
31V	101ASIX1	ESPAWS Computer	172.45	20*	8.6	NA	–	–
31V	101ASIX2	ESPAWS Land Navigation System	286.39	20**	14.3	NA	–	–
63B	610-63B10	Power Generation and Vehicle Mech.	991.9	20*	49.6	NA	–	–
63C	611-63010	Track Vehicle Mechanic	347.9*	20*	17.4	62	1078.8	.9
13B	041-ASIU6	Field Artillery Weapons Mechanic Course	1253.2	40	31.33	73	2287.09	1.8
13B	041-13B10 (MOD)	Field Artillery Crewmen (MOD)	2756	40*	68.9	NA	–	–

Table C5-2. Reference Instructor Determination Worksheet

MOS	Course Number	Course	(A) Total ICH per Class	(B) Optimum Class Size	(C) ICH Per Student (A – B)	(D) Number of Students	(E) Total ICH (C) x (D)	Number of Instructors (E) – 1250
13B	041-13B10	Field Artillery Crewman	2741.5	40*	68.5	NA	–	–
(45D)	643-45D10 (MOD)	Field Artillery Turret Mechanic	479.2*	20*	23.96	832	19934.72	15.9
31V	101-31V10	Tactical Communications Systems Operator	2166.7	35	61.9	NA	–	--
41C	670-41C10	Fire Control Instrument Repair	2116.4	14	151.1	39	5892.9	4.7
44B	700-44B10	Metalworker	1326.0	18	73.7	47	3463.9	2.8
45K	643-45K10	Tank Turret Repair	1166.8	18	64.8	450	29160	23.3
45L	642-45L10	Artillery Repair	914.3	14	65.3	228	14888.4	11.9
45L	642-ASIX1	ESPAWS Autoloader	291.5	20*	14.6	66	963.6	.8
31V	101ASIX1	ESPAWS Computer	172.45	20*	8.6	798	6862.8	5.5
31V	101ASIX2	ESPAWS Land Navigation System	286.39	20**	14.3	798	11411.4	9.1
63B	610-63B10	Power Generation and Vehicle Mech.	991.9	20*	49.6	NA	–	–
63C	611-63C10	Track Vehicle Mechanic	347.9*	20*	17.4	62	1078.8	.9
13B	041-ASIU6	Field Artillery Weapons Mechanic Course	1253.2	40	31.3	NA	–	–
13B	041-13B10 (MOD)	Field Artillery Crewmen (MOD	2756	40*	68.9	5112	352216	281.8

Table C5-3. Conceptual Instructor Determination Worksheet

MOS	Course Number	Course	(A) Total ICH per Class	(B) Optimum Class Size	(C) ICH Per Student (A – B)	(D) Number of Students	(E) Total ICH (C) x (D)	Number of Instructors (E) – 1250
13B	041-13B10	Field Artillery Crewman	2741.5*	40*	68.5	NA	–	–
(45D)	643-45D10 (MOD)	Field Artillery Turret Mechanic	479.2*	20*	24.	160	3840	3.1
31V	101-31V10	Tactical Communications Systems Operator	2166.7	35	61.9	152	9408.8	7.5
41C	670-41C10	Fire Control Instrument Repair	2116.4	14	151.1	39	5892.9	4.7
44B	700 44B10	Metalworker	1326.0	18	73.7	47	3463.9	2.7
45K	643-45K10	Tank Turret Repair	1166.8	18	64.8	450	29160	23.3
45L	642-45L10	Artillery Repair	914.3	14	65.3	271	176963	14.2
45L	642-ASIX1	ESPAWS Autoloader	291.5*	20*	14.6	37	540.2	.4
31V	101ASIX1	ESPAWS Computer	172.45*	20*	8.6	798	6862.8	5.5
31V	101ASIX2	ESPAWS Land Navigation System	286.39*	20**	14.3	578	8265.4	
63B	610-63B10	Power Generation and Vehicle Mech	991.9*	20*	49.6	NA	–	–
63C	611-63C10	Track Vehicle Mechanic	347.9*	20*	17.4	62	1078.8	.9
13B	041-ASIU6	Field Artillery Weapons Mechanic Course	1253.2	40	31.3	NA	--	–
13B	041-13B10 (MOD)	Field Artillery Crewmen (MOD)	2756*	40*	68.9	5741	395554.9	316.4

ESPAWS predecessor reference, and conceptual systems respectively. The number of replacement personnel on these sheets was obtained directly from the analyses conducted in Section 8.3.3. For existing courses with readily available data, instructor contact hours per class (ICH) and optimum class size were obtained from the instructor contact hour summary on the TRADOC Form 377-R associated with the course.

Forms for some of the existing courses were not received in time to be utilized in this study. For existing course with missing data and for newly developed or modified courses, the optimum class size was assumed to be twenty except for the 13B AIT/OSUT course where a class size of forty was used. The value of twenty for the optimum class size was selected for most courses because it appeared to be about the average optimum class size (based on the rather small sample which DRC had available). A larger value of forty was selected for the 13B AIT/OSUT course because it was an OSUT course and these courses tended to have higher optimum class sizes. Actually, the selection of optimum class size is arbitrary since it is cancelled out by the optimum class size factor in the instructor contact hour determination algorithm described below. It is included to provide results that more closely resemble the step-by-step results listed in DA PAM 520-558.

Instructor contact hours for the modified or newly developed courses or existing courses with missing data were determined utilizing the algorithm determined in the next section.

C5.2 Instructor Contact Hours Determination

The algorithm used to determine contact hours for a given course was as follows

$$\sum_{I=1}^{T} H_i \times \frac{OC}{SI_i}$$

where T is the number of different types of instructional methods used in the course; H_i is the number of hours associated with the ith method, OC is the optimum class size and SI is the student instructor ratio for the ith instructional type.

Using the formula described above, instructor contact hours for both the modified or newly developed ESPAWS courses and the existing courses which lacked available data were determined. Table C5-4 summarizes the calculations associated with the application of this algorithm. The student instructor ratio for the instructional types were taken directly form the recommended values listed in DA PAM 570-558. The hours associated with each instructor type were either taken directly from the POI (for existing courses) or the course development/modification worksheets (for modified or newly developed courses).

Table C5-4. Determination of Instructor Contact Hours

Course	Inst. Type	S/I Ratio	Optimum Class Size	Hours	ICH per Type
643-45D10	C	20	20	23.8	23.8
	D	20	20	1.0	1.0
	F	20	20	.9	.9
	TV	20	20	2.6	2.6
	PE1	6	20	99.5	326.7
	PE2	6	20	1.0	3.3
	PE3	20	20	12.2	12.2
	E1	6	20	33.0	108.9
					479.4
611-63C10	C	20	20	.5	.5
	F	20	20	.5	.5
	TV	20	20	.5	.5
	PE1	6	20	11.5	37.9
	SP	20	20	251.7	251.7
	E1	20	20	57.3	57.3
					347.9
611-63B10	C	20	20	17.5	17.5
	D	20	20	1.0	1.0
	PE1	6	20	189.3	625.7
	PE2	6	20	3.5	11.5
	PE3	20	20	4.0	40.0
	E1	6	20	51.3	171.0
	E2	6	20	2.5	8.3
	E3	20	20	.7	.7
	F	20	20	.5	.5
	SP	20	20	115.7	115.7
					991.9
041-13B10	C/E3	20	40	50.75	101.5
	PE1	6	40	398.25	2655.0
					2756
041-13B10 (MOD)	C/E3	20	40	50.25	100.5
	PE1	6	40	396.25	2641.0
					2741.5
101ASIX1	PE1	6	20	41.9	138.2
	TV	20	20	2.4	2.4
	D	20	20	3.2	3.2
	C	20	20	3.6	3.6
	F	20	20	.3	.3
	E1	6	20	7.5	24.75
					172.45

Table C5-4 (continued)

Course	Inst. Type	S/I Ratio	Optimum Class Size	Hours	ICH per Type
101ASIX2	SP	20	20	9	9.0
	C	20	20	1.0	1.0
	PE1	6	20	65.8	217.14
	PE2	6	20	11.0	36.3
	PE3	20	20	1.5	1.5
	E1	6	20	4.5	14.85
	E2	6	20	2.0	6.6
					286.39
642-ASIX1	C	20	20	20.8	20.8
	D	20	20	3.8	3.8
	PE1	6	20	66.8	220.44
	E1	6	20	14.1	46.5
					291.54

APPENDIX C6
COURSE COSTING WORKSHEETS

This appendix describes the procedures and input data which were utilized to determine training course costs for the ESPAWS predecessor, reference, and conceptual systems. The first section describes the specific calculations used in developing estimates of the cost per student for each individual course. The second section describes the specific calcualtions that were used to determine three additional measures of training course cost (average individual training cost, replacement personnel training cost, and cumulative personnel training cost).

C6.1 Determination of Individual Course Costs

Estimates of the cost per student for existing courses were determined directly from MOS Training Cost Handbook. Estimates of the cost per student for modified or newly developed courses were determined by identifying a comparable existing course, obtaining relevant cost data on the existing course from the MOS Training Cost Handbook, and modifying this cost data to reflect differences between the course lengths of the existing and projected course. Table C6-1 displays the algorithm that was used in modifying the cost data of the comparable course. Basically, this algorithm reduces (increases) the variable Military Personnel, Army (MPA) appropriation portion of the existing course costs in direct proportion to percentage decrease (increase) in course length associated with the projected

Table C6-1. Algorithm Used in Determining Course Cost per Student for Modified Courses.

$$\frac{CL(NEW)}{CL\ (EXIST)} \times VMPA(EXIST) - VMPA(EXIST) + CPS(EXIST) = CPS(NEW)$$

CL(NEW)	=	Course length for modified or newly developed course
CL(EXIST)	=	Course length for existing course
VMPA(EXIST)	=	Variable military pay and allowances for existing course
OCPS(EXIST)	=	Overall cost per student for the individual course
CPS(NEW)	=	Overall cost per student for the modified or newly developed course

course. It then adds (subtracts) the obtained difference between the existing and projected variable MPA costs to the overall cost of the existing course[1].

Table C6-2 lists the specific calculations used in determining course cost per student for each of the modified or newly developed ESPAWS courses.

C6.2 Training Course Cost Measures

Four different training course cost measures were calculated: Individual Student Cost Per Course - the cost to train an individual in an particular course (the procedures for determining this measure were described in C6.1).

Average Individual Training Cost - the average individual provides an estimate of what it would cost to train one individual who completed all of the courses contained in the training path for a particular MOS. It is determined by the following equation:

$$\sum_{i=1}^{n} CPS_i \; W_i$$

where n is the number of courses in the training path; CPS is the cost per student for the ith course, and W_i is the percentage of personnel in the MOS taking that course within

[1] More sophisticated procedures for modifying existing course costs are currently being developed.

Table C6-2. Course Cost Modification Sheet.

Course: 642-ASIX1 Existing course used in estimation: 041-ASIU6 – Field Artillery Weapons Mechanic

$\frac{\text{CL(NEW)} \quad 3.4}{\text{CL(EXIST)} \quad 5.0}$ x MPA(EXIST) 1110 – VMPA 1110 + Course Cost (EXIST) 2274 = New Course Cost 1918.8

Course: 041-13B10 (MOD) Existing course used in estimation: 041-13B10

$\frac{\text{CL(NEW)} \quad 12.5}{\text{CL(EXIST)} \quad 12.4}$ x MPA(EXIST) 1537 – VMPA 1537 + Course Cost (EXIST) 4344 = New Course Cost 4356

Course: 101ASIX2 Existing course used in estimation: 101-ASIF7 – FADAC Mechanic

$\frac{\text{CL (NEW)} \quad 2.8}{\text{CL(EXIST)} \quad 2.8}$ x MPA(EXIST) 920 – VMPA 920 + Course Cost (Exist) 2351 = New Course Cost 2351

Course: 101-ASIX1 Existing course used in estimation: 101-ASIF7 – FADAC Mechanics

$\frac{\text{CL(NEW)} \quad 1.89}{\text{CL(EXIST)} \quad 2.8}$ x MPA(EXIST) 920 – VMPA 920 + Course Cost (EXIST) 2351 = New Course Cost 20.52

Course: 643-45D10 Existing course used in estimation: 642-45L10 – Artillery Repair

$\frac{\text{CL(NEW)} \quad 5.2}{\text{CL(EXIST)} \quad 10.4}$ x VMPa (exist) 3379 – VMPA 3324 + Course Cost (Exist) 9865 = New Course Cost 8200.5

the skill level in which the course is located. W_i will generally be one except for special system specific courses (e.g., ESPAWS computer course) which are only taken by a portion of the individuals in an MOS.

Replacement Personnel Training Cost - replacement personnel training cost for an MOS determined by the following equation:

$$\text{Replacement Cost} = \sum_{i=1}^{n} (CPS_i \times NREP_i)$$

Where CPS_i is the cost per student for the ith course and NREP is the number of replacement personnel taking that course.

Cumulative Personnel Training Costs - the cumulative personnel training cost for each course ($CPER_i$) provides an estimate of what it has cost to train all the individuals at a particular point in the career path from basic training up to, and including, that course. It is determined by the following equation:

$$CPER_i = \left(\sum_{j=1}^{i} CPS_j \times W_j \right) \times NREP_i$$

where $CPER_i$ is the cumulative training cost for the ith course in the career path; CPS_j is the cost per student for jth course in the career path; W_j is the percentage of personnel in the MOS taking the jth course within the skill

level in which the ith course is located; and $NREP_i$ is the number of replacement personnel taking the ith course.

Table C6-3 displays the worksheets used to develop the four cost measures described above for the ESPAWS predecessor, reference, and conceptual systems. For each course in the training path, the following is listed: (a) the cost per student (CPS) - weighted costs are listed in parentheses, (b) the number of replacement personnel taking the course (NREP), (c) the replacement personnel costs for that path (axb), (d) the cumulative course costs (the sum of the course costs for that and all previous paths), and (e) the cumulative personnel training cost per course (bxd).

The Average Individual Training Cost is the sum of the weighted CPS costs in column A. The Replacement Personnel Training Cost is the sum of the costs in column C.

Table C6-3. Training Cost Worksheet.

MOS 13B Predecessor X Reference ____ Conceptual ____

THAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	9243	27,719,757	2999	27,719,757
1	Rec.	Reception	261	9243	2,412,423	3260	30,132,180
1	041-13-B10	Field Artillery Crewman	4344	9243	40,161,592	7604	70,283,772
1	LV-AD1	Leave/Administration	724	9243	6,691,932	8328	76,975,704
1	041 ASIU6	Field Artillery Weapons Mechanic	(2274)	73	166,002	(10602)	816,354
			18	(73) .008	(1314)	8346	(609,268)
2	04113B30	Primary NCO	6209	1116	6,929,244	14555	16,243,380
3	BNOCBB	Basic NCO	4114	640	2,632,960	18669	76,804,266
4	013C42	Advanced NCO	8954	28	250,712	27623	773,444
TOTAL			27,623		86,954,622		

Table C6-3. Training Cost Worksheet. (continued)

MOS 13B Predecessor ____ Reference X Conceptual ____

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	5112	15,330,888	2999	15,330,888
1	Rec.	Receptee	261	5112	1,334,232	3260	16,665,120
1	041-13B10* (MOD)	Field Artillery Crewman	4356*	5112	22,267,872	7616	38,932,992
1	LV-AD1	Leave/Administration	724	5112	3,701,088	8340	6,038,160
2	041-13B30	Primary NCO	6209	1116	6,923,035	14549	16,222,135
3	BNCOC13B	Basic NCO	4114	640	2,632,960	18663	11,944,320
4	0-13-C42-ADV	Advanced NCO	8954	0	0	27617	0
TOTAL			27,617		52,190,075		

Table C6-3. Training Cost Worksheet. (continued)

MOS 13B Predecessor _____ Reference _____ Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	5741	172,117,259	2999	172,117,259
1	Rec.	Receptee	261	5741	1,498,401	3260	18,715,660
1	041-13 B10* (MOD)	Field Artillery Crewman	4356*	5741	25,007,796	7616	43,723,456
1	LV-AD1	Leave/Administration	724	5741	4,156,484	8340	47,879,940
2	041-13B30	Primary NCO	6209	1115	6,923,035	14549	16,222,135
3	BNCOC13B	Basic NCO	4114	640	2,632,960	18663	11,944,320
4	0-13-C42-ADV	Advanced NCO	8954	0	0	27617	0
TOTAL			27,617		57,430,401		

Table C63. Training Cost Worksheet. (continued)

MOS 31V Predecessor X (none) Reference ____ Conceptual ____

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	0	0	2999	0
1	REC	Receptee	261	0	0	3260	0
1	160-31V10 (160-101-31V 10)	Tactical Communication Systems Operator	2898	0	0	6158	0
1	LV/ADI	Leave/Administration	724	0	0	6882	0
2	PLC	Primary Leadership Training	2893	0	0	9775	0
3	(10V31V30)	Tactical Electronic Equipment Basic NCO	4872	0	0	14647	0
4	IEE C429	Tactical Electronic Equipment Advanced NCO	6953	0	0	21600	0
TOTAL			21,600		0		

Table C6-3. Training Cost Worksheet. (continued)

MOS 31V Predecessor ____ Reference X Conceptual ____

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	798	2,393,202	2999	2,393,202
1	REC	Receptee	261	798	208,278	3260	850,860
1	160-31V10	Tactical Communication System Operator	2898	798	2,312,604	6158	4,914,084
1	LV/ADI	Leave/Administration	724	798	577,752	6882	5,491,836
1	101ASIX1* (new)	ESPAWS Computer	2351*	798	1,876,098	9233	7,367,934
2	PLC	Primary Leadership Training	2893	578	1,672,154	12126	7,008,828
2	101ASIX2*	ESPAWS Land Navigation System	2052*	578	1,186,056	14178	8,194,884
3	10V31V30	Tactical Electronic Equipment Basic NCO	4872	0	0	19050	0
4	IEE-C42B	Tactical Electronic Equipment Advanced NCO	6953	0	0	26003	0
TOTAL			26,003		10,226,144		

Table C6-3. Training Cost Worksheet. (continued)

MOS 31V Predecessor ____ Reference ____ Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	152	455,848	2999	[illegible]5,848
1	REC	Receptee	261	152	39,672	3260	495,520
1	160-31V10 (160-101-31V 10)	Tactical Communication System Operator	2898	152	440,496	6158	936,016
1	LV/ADI	Leave/Administration	724	152	110,048	6882	1,046,064
1	101ASIX1* (new)	ESPAWS Computer	2351*	152	357,352	9233	1,403,416
2	PLC	Primary Leadership Training	2893	0	0	12126	0
2	101ASIX2*	ESPAWS land Navigation System	2052	0	0	14178	0
3	10V31V30	Tactical Electronic Equipment Basic NCO	4872	0	0	19050	0
4	IEE-C42B	Tactical Electronic Equipment Advanced NCO	6953	0	0	26003	0
TOTAL			26,003		1,403,416		

Table C6-3. Training Cost Worksheet. (continued)

MOS 41C Predecessor X Reference X Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	39	116,961	2999	116,961
1	REC	Reception	261	39	10,179	3260	127,140
1	670-41C20 (670-41C10)	Fire Control Instrument Repair	29615	39	1,154,985	32875	1,282,125
1	LV/ADI (41C20)	Leave/Administration	724	39	33,599	33599	1,310,361
2	PLC (41C20)	Primary Leadership Training	2893	0	0	36492	0
3	6-MM-C40 (41C30)	Mech. Maint. Basic NCO Course	10672	0	0	47164	0
4	6-63-C42 (41240)	Mech. Maint. Advanced NCO	7996	0	0	55160	0
TOTAL			55,160		1,310,361		

Table C6 3. Training Cost Worksheet. (continued)

MOS 44B Predecessor X Reference X Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	47	140,953	2999	140,953
1	REC	Receptee	261	47	12,267	3260	153,220
1	LV/ADI	Leave/Administration	724	47	34,028	3984	187,248
1	704-44B20 (44B10)	Metal Worker	8566	47	402,602	12550	589,850
2	PLC (44B20)	Primary Leadership Training	2893	0	0	15443	0
3	6-MM-C40 (44B30)	Mech. Maint. Basic NCO Course	10672	0	0	26115	0
TOTAL			26,115		589,850		

Table C8-3. Training Cost Worksheet. (continued)

MOS 45D (13BU6) Predecessor ____ Reference X Conceptual ____

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	832	2,495,168	2999	2,495,168
1	REC.	Receptee	261	832	217,152	3260	2,712,320
1	643-45D10*	Field Artillery Turret* Mechanic	8200*	832	6,822,400	11460	9,534,720
1	LV-AD1	Leave/Administration	724	832	602,368	12184	10,137,088
2	641-13B30	Primary NCO	6209	47	291,823	18393	864,471
3	BNCOC13B	Basic NCO	4114	0	0	22507	0
4	8-13-C42-ADV	Advanced NCO	8954	29	259,666	31461	912,369
TOTAL			31,461		10,688,577		

Table C6-3. Training Cost Worksheet. (continued)

MOS 45D (13BU6) Predecessor ____ Reference ____ Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	160	479,840	2999	479,840
1	REC	Reception	261	160	41,760	3260	521,600
1	943-45D10* (MOD)	Field Artillery* Turret Mechanic	8200*	160	1,312,000	11460	1,833,600
1	LV-AD1	Leave/Administration	724	160	115,840	12184	1,949,440
2	041-13B30	Primary NCO	6209	47	291,823	18393	901,257
3	BNCOC13B	Basic NCO	4114	0	0	22507	0
4	0-13-C42-ADV	Advanced NCO	8954	29	259,666	31461	912,369
TOTAL			31,461		2,500,929		

Table C6-3. Training Cost Worksheet. (continued)

MOS 45K Predecessor X Reference ____ Conceptual ____

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	333	998,667	2999	998,667
1	REC	Receptee	261	333	86,913	3260	1,085,580
1	643-45K20 (643-65K10)	Tank Turret Repairer	13748	333	4,578,084	17008	5,663,664
1	LV/ADI (45K10)	Leave/Administration	724	333	241,092	17732	5,904,756
2	PLC (45K20)	Primary Leadership Training	2893	109	315,337	20625	2,248,125
3	8-MM-C40 (45K30)	Mech. Maint. Basic NCO	10672	0	0	31297	0
TOTAL			31,297		6,220,093		

Table C6-3. Training Cost Worksheet. (continued)

MOS 45K Predecessor ____ Reference X Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	450	1,349,550	2999	1,349,550
1	REC	Receptee	261	450	117,450	3260	1,467,000
1	643-45K20 (643-85K10)	Tank Turret Repairer	13748	450	6,186,600	17008	7,653,600
1	LV/ADI (45K10)	Leave/Administration	724	450	325,800	17732	7,979,400
2	PLC (45K20)	Primary Leadership Training	2893	146	422,378	20625	3,011,250
3	6-MM-C40 (45K30)	Mech. Maint. Basic NCO	10672	0	0	31297	0
TOTAL			31,297		8,401,778		

Table C6-3. Training Cost Worksheet. (continued)

MOS 45L Predecessor X Reference ____ Conceptual ____

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	114	34,086	2999	341,886
1	REC	Reception	261	114	29,754	3260	371,640
1	642 45L10	Artillery Repair	9865	114	1,124,610	13125	1,496,250
1	LV/ADI (45L10)	Leave/Administration	724	114	82,536	13849	1,578,786
2	PLC (45L20)	Primary Leadership Training	2893	50	144,650	16742	837,100
3	6-MM-C49 (45L30)	Mech. Maint. Basic NCO Course	10672	0	0	27414	0
4	6-63-C42 (45L40)	Mech. Maint. Advanced NCO Course	7996	0	0	35410	0
TOTAL			35,410		1,415,636		

Table C83. Training Cost Worksheet. (continued)

MOS 45L Predecessor ____ Reference X Conceptual ____

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	228	683,772	2999	683,772
1	REC	Reception	261	228	59,508	3260	743,280
1	642-45L20 (642-45L10)	Artillery Repair	9865	228	2,249,220	13125	2,992,500
1	LV/ADI (45L20)	Leave/Administration	724	228	165,072	13849	3,157,572
1	642ASIX1	ESPAWS Autoloader	(1918) 556	66 (66) .29	126,588	(15767)	1,040,622
2	PLC (45L20)	Primary Leadership Training	2883	50	144,650	17298	864,900
3	8-M88 C40 (45L30)	Mech. Maint. Basic NCO Course	10672	0	0	27970	0
4	8-63-C42 (45L40)	Mech. Maint. Advanced NCO Course	7996	0	0	35966	0
TOTAL			35,966		3,428,810		

Table C6 3. Training Cost Worksheet. (continued)

MOS 45L Predecessor ____ Reference ____ Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	271	812,729	2999	812,729
1	REC	Receptee	261	271	70,731	3260	850,860
1	642-45L10	Artillery Repairs	9865	271	2,673,415	13125	3,556,875
1	LV/ADI (45L10)	Leave/Administration	724	271	196,204	13849	3,753,079
1	642ASIX1	ESPAWS Autoloader	(1918) 269	37 (37) .14	70,966 (9916)	(15767) 14117	583,379 (522,329)
2	PLC (45L20)	Primary Leadership Training	2893	50	144,650	17010	850,500
3	6-MM-C40 (45L30)	Mech. Maint. Basic NCO Course	10672	0	0	27682	0
4	6-63-C42 (45L40)	Mech. Maint. Advanced	7996	0	0	35678	0
TOTAL			35,678		3,968,695		

Table C6 3. Training Cost Worksheet. (continued)

MOS 63B Predecessor X Reference X Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	0	0	2999	0
1	REC	Receptee	261	0	0	3260	0
1	610-63B20	Power Generation and Vehicle Mech.	3867	0	0	7127	0
1	LV/ADI (63B10	Leave/Administration	724	0	0	7851	0
2	PLC (63B20)	Primary Leadership Training	2893	0	0	10744	0
3	646-45J40E (63B30)	Mech. Maint. Basic NCO Course	7871	29	228,259	18615	539,835
4	6-63 C42 (63B40)	Mech. Maint. Primary NCO	7996	0	0	26611	0
TOTAL			26,611		228,259		

Table C8.3. Training Cost Worksheet (continued)

MOS 63C Predecessor X Reference Conceptual

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	62	185,938	2999	185,938
1	REC	Reception	261	62	16,182	3260	202,120
1	811 63C20 (811 63C10)	Track Vehicle Mechanic	12602	62	781,324	15862	983,444
1	LV/ADI (63C10)	Leave/Administration	724	62	44,888	16586	1,028,332
2	PLC (63C20)	Primary Leadership Training	2893	42	121,506	19479	818,118
3	6 MM C40 (63C30)	Mech. Maint Basic NCO Course	10672	27	288 144	30151	814,077
4	6 63 C42 (63C40)	Mech Maint Advanced NCO	7996	0	0	38147	0
TOTAL			38,147		1,437,982		

Table C6.3. Training Cost Worksheet (concluded)

MOS 63C Predecessor ____ Reference X Conceptual X

TRAINING COURSE COST

(A) Paygrade/ Skill Level	(B) Course Number	(C) Course	(D) Course Cost	(E) No. of Replacement Personnel	(F) Replacement Personnel Training Cost (D) x (E)	(G) Cumulative Course Cost	(H) Cumulative Personnel Training Cost (E) x (G)
1	BCT	Basic Training	2999	62	185,938	2999	185,938
1	REC	Receptee	261	62	161,182	3260	202,120
1	611 63C20 (611 63C10)	Track Vehicle Mechanic	12602	62	781,324	15862	983,444
1	LV/ADI (63C10)	Leave/Administration	724	62	44,888	16586	1,028,332
2	PLC (63C20)	Primary Leadership Training	2893	84	243,012	19479	1,636,236
3	6 MM C40 (63C30)	Mech Maint Basic NCO	10672	27	288,144	30151	814,077
4	6 63 C42 (63C40)	Mech Maint Advanced NCO	7996	0	0	38147	0
TOTAL			38,147		1,704,488		